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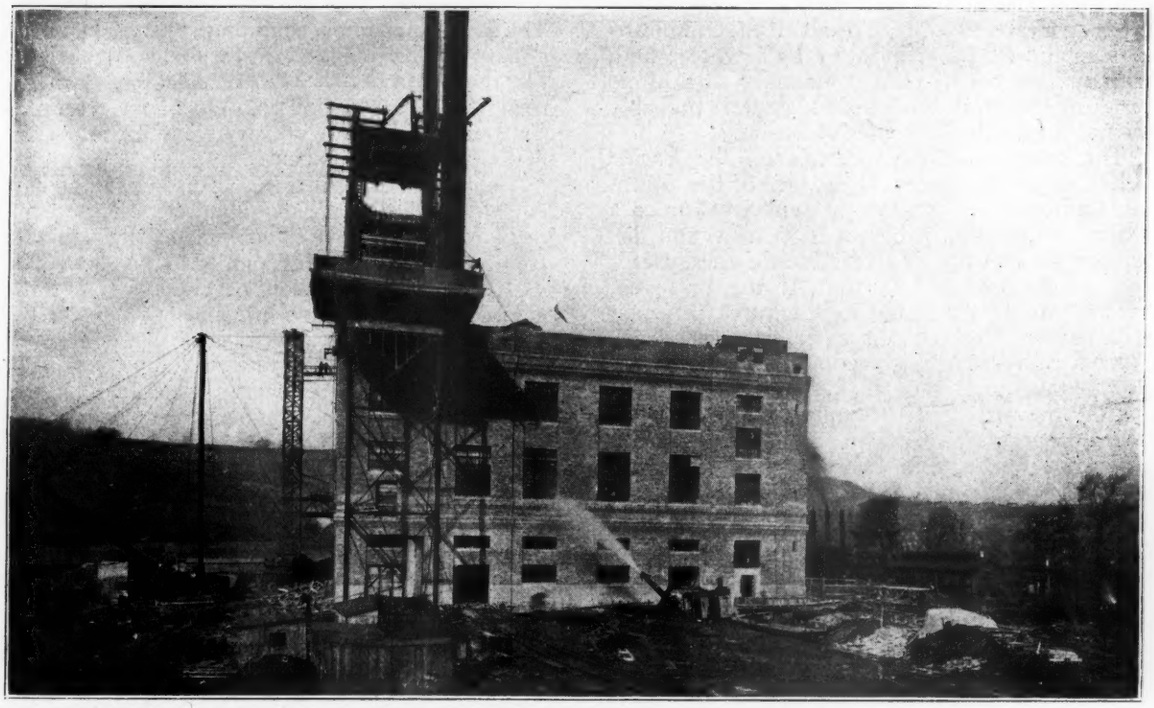

Power Plant Under Construction by Dwight P. Robinson & Co., at Seward, Pa., for the Penn Public Service Corp.

Big Spring Construction Program Outlined by Utilities

What It Means to Central-Station Companies, Their Customers, to Electrical Manufacturers, Contractors, Dealers, Industrial Plants and Civic Development in Every Part of the Country

By C. A. TUPPER

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From letters and replies to questionnaires received by the ELECTRICAL REVIEW it is apparent that a heavy construction program, to start this spring, has been decided upon by a large number of the electric light and power companies of the country. This is one of the first concrete examples of the effects of the campaign inaugurated some time ago by the National Electric Light Association to bring about better relations between the utilities and the public, as the money with which to pay for the extensions and improvements will come largely from acceptance by the public of the stocks and bonds of electric light and power companies.

The effect of the good-will campaign mentioned, which was outlined at considerable length in the Feb. 19 issue of the ELECTRICAL REVIEW, has been of a cumulative character. Its benefit to the utilities has rolled up rapidly during the past few months. Back in the early fall of 1920 it would have taken a bold and hardy spirit to have predicted the success with which public service corporation securities have since been placed on the market, but recently there has been such a change of public sentiment and of the attitude of investment bankers and others toward the utilities that a definite program of much needed expansion and betterment has been made possible in nearly all parts of the country.

As will be seen from the following review, the new construction program consists largely of additions to generating capacity with all that this

implies in the way of transmission, distribution and control, and the effect of it will be felt in the increased application of electric power to industrial, civic and domestic requirements. Every dollar spent primarily for an increase in station capacity, therefore, means other dollars expended farther down the line.

Computations made on an actuarial basis show that the installation of each kilowatt of generating capacity means an average of about $1100 in business to the electrical industry as a whole; and, with the growth of each community as a direct result of electrical development, there is probably a greater gain in other lines of business.

The greatest activity prevails on the Pacific Coast, where one system alone, that of the Southern California Edison Co., has embarked upon a 15-yr. construction program to develop and distribute 750,000 hp. of hydroelectric energy at a cost of $200,000,000. 1921 is the first year of this program and the expenditures this year will include $8,000,000 for water-power development and from $4,000,000 to $6,000,000 for distribution and general system expenditures. During this year it will complete the Kern River No. 3 property of 40,000 hp., the Big Creek No. 8 of 30,000 hp., and in February an addition of 22,000 hp. was completed and put in operation at the Big Creek No. 2 power plant. This gives 92,000 hp. additional water power.

The company is, at the same time, working actively upon a 13-mi. tunnel, connecting Huntington lake, the present reservoir for the Big Creek plants, with Florence lake, which, when completed in 3 or 4 yrs., will bring in from another watershed about four times as much water as is now available for these Big Creek plants, whereupon additional generating units will be installed in each of them. During the progress of this work and subsequent thereto, five additional plants will be constructed on Big Creek and the San Joaquin river for the further use of these waters.

This tremendous program is indicative of the trend of other projects on the Pacific Coast. In California the major part of electrical construction, comprising work recently completed and that which is in progress, centers in the activities of the large power companies of the state. It represents the efforts of those companies to greatly increase their generating capacity without drawing on fuel supplies. That is, the new power plants, and the additional units to be installed in previously built plants, represent mainly hydroelectric development.

Those public utilities which feed electric power to the great centers of population and industry around San Francisco Bay, and the delta regions of Stockton and Sacramento, comprise the Pacific Gas & Electric Co., Great Western Power Co. and the Western States Gas & Electric Co. The Pacific Gas & Electric Co. is centering its energies mainly on its Pit river development, in Shasta county. The Great Western Power Co., which has been engaged on its Caribou development on the north fork of Feather river, in Plumas county, during the last 2 yrs., expects to have its new 40,000-kw. plant in operation early this year.

The San Joaquin Light & Power Corp., with principal offices at Fresno, supplies energy to the cities and towns and irrigated regions of the central and southern portions of the San Joaquin valley. In the Bakersfield district a considerable load on its lines is for oil pumping. This company's power-producing capacity was reinforced a few months ago by the completion of its 30,000-kw. generating plant on the San Joaquin river, known as the Kerckhoff project. The company's Kern river hydroelectric plant, near Bakersfield, is being rebuilt and the old equipment replaced. The same company is equipping, near Bakersfield, a plant comprising a steam turbine and generator for the operation of which natural gas will be used as fuel under boilers. On Kings river this company is doing preliminary work for important hydroelectric development.

The Southern California Edison Co. of Los Angeles, whose principal hydroelectric development is on the Kern river, and on Big Creek, a tributary of the San Joaquin, has fully completed its Kern River No. 3 plant of 30,000 kw., and has completed a new 16,500-kw. unit at its No. 2 Big Creek plant. Its 22,500-kw. plant No. 8 on lower Big Creek is well along toward completion. The principal part of the energy generated by this company's main generating plants on Kern river and Big Creek is transmitted across the Tehachapi Pass to Los Angeles over high-tension power lines. Well-matured plans provide for the construction of several other hydroelectric plants in the Big Creek watershed and on the San Joaquin.

The Los Angeles Gas & Electric Corp. is working on the installation of a 10,000-kw. turbo-generator unit.

The Southern Sierras Power Co. has about completed No. 1 Adams hydroelectric plant, of 3000-kw., in Owens river gorge, and has under construction No. 2 Adams plant of 10,000 kw. in the same gorge. The latter involves considerable tunnel driving. Development for hydroelectric power on Lee Vining creek, which was in progress last year, will be continued through 1921. The sum of $70,000 has been appropriated for construction work on Rush Meadows dam. About $12,000 has been apportioned to upper Bishop Creek for enlarging the spillway dam and for installing measuring weirs. Other Bishop Creek improvements will consist of the installation of additional transformers, and a spare transformer at the Rush Creek plant. About $180,000 is to be expended for improving and extending the company's distribution system in Imperial Valley. This includes line extensions and transformer installations. The Southern Sierras engineering work is under direction of C. O. Poole, chief engineer, Riverside, and W. L. Huber, consulting engineer, San Francisco.

California-Oregon Power Co., which operates seven hydroelectric plants of a combined capacity of 21,000 kw., serves northern California and southern Oregon. A little more than half of its power production is by its California plants. Its largest development is at the 11,500-kw. Copco plant on the Klamath river, Shasta county, Cal. Construction work to begin this spring will consist of building a concrete dam across Link river which forms the outlet of Klamath lake in southern Oregon, and which flows into Klamath river. The purpose of the proposed dam is to greatly increase the storage capacity of Klamath lake, affording an abundant supply of water for power and irrigation. An 8-mi. transmission line of

38,000 volts is to be erected this season from Klamath Falls, Ore., to Algoma, to deliver power to a sawmill and other interests. A 600-kw. substation will be built at Algoma. This company has 160 mi. of 66,000-volt transmission lines and about 305 mi. of lines carrying 38,000 volts. Its longest line is that extending from Copco to Kennett where this system ties in with that of Pacific Gas & Electric Co.

General Outline and Features of Feather River Development.

Reference has already been made to the nearly completed Caribou hydroelectric plant of the Great Western Power Co. on the north fork of Feather river, in California. The new plant is about 50 mi. upstream from that company's Las Plumas plant, built several years ago. A general outline of the Caribou development will be of interest at this time while the construction forces are on the closing stages of the job. The work is being put through by Stone & Webster, Inc., whose work has required a small power plant for construction purposes, railroad building and camp equipment for a large force. In connection with the Great Western Power Co.'s original development, the Big Meadows dam was built across the north fork of the Feather, creating Lake Almenor as a vast storage basin. The plans of the later Caribou project provided for tapping that storage basin and conducting about 800 sec. ft. of water through a series of tunnels and channels a distance of 44,520 ft. to the powerhouse, giving a head of 1100 ft.

In more detail, the construction work, now nearly completed, was as follows: Tunnel No. 1 was driven 11,200 ft. southerly, whereby water from the lake is conducted into Butt creek channel which runs southwesterly. This creek channel carries the water 4 mi. to the Butt creek dam by which the stream is diverted into No. 2 tunnel, which was driven 9200 ft. southeasterly, connecting at its lower end with No. 3, a presure tunnel having a length of 3000 ft. At the upper end of the pressure tunnel is a concrete surge tank, 30 ft. diam., and 175 ft. high, that serves as a forebay. The lower three-fourths of No. 3 tunnel contains riveted-steel pressure pipes by which the water is conducted to the power house. The first section consists of two pipes, each 66 ins. diam., the second section consisting of two 60-in., and the latter branching into four 42-in. pipes. That is, there are two pressure-pipe units for the two generating units.

Tunnel No. 1, which cuts through shale, slate and sandstone, is over 80% complete. In cross-section it is 7 ft. wide at base, 5.5 ft. wide at top and 7 ft. high, and is being lined with timber structure. Tunnel No. 2, which has been driven through, is circular, 10 ft. diam., and is being concrete lined. No. 3, pressure tunnel, is circular in form, 10 ft. diam., and is being concrete lined.

The concrete power-house contains two generating units, each of the capacity of 20,000 kw. Each unit is made up of an Allis-Chalmers 30,000-hp. turbine and a General Electric 20,000-kw. generator. As previously stated, the turbines will operate under a head of 1100 ft., and the plant is expected to be ready for service by April or May. Energy generated at 11,000 volts will be transmitted at 165,000 volts over a steel-tower line to San Francisco Bay, a distance of 190 mi. This line, which is practically completed, is made up of aluminum conductors with steel cores.

Summary of Pit River Development.

The Pacific Gas & Electric Co. has under construction three hydroelectric plants in the eastern part of Shasta county in which there will be utilized the waters of Hat creek and Fall river, both of those streams being tributaries of Pit river. The watershed drained by Pit river and its feeders covers parts of Shasta, Lassen, Modoc and Siskiyou counties. The Pit, which flows westerly to the Sacramento, carries an average volume of 2500 sec. ft. Its source in a region of springs and lakes gives it a quite constant flow. Fall river, flowing from the north into the Pit, has a maximum flow of 1543 sec. ft. and a minimum of 1282. Hat creek, running into Pit river from the south, has a maximum flow of 700 sec. ft. and a minimum of 583. It will be observed that the variation of the flow of those streams is not great. The powerhouse sites for this development are within a few miles of each other, the plateau in that locality being about 3300 ft. above sea level.

The two plants on Hat creek are to be completed early this season. No. 1 plant is at a point where Rock creek joins Hat creek. The equipment comprises one vertical turbine of 15,000 hp. and a 12,500-kv-a. generator. The turbine will be operated under a 217-ft. head, the water to be conducted from the diversion point through 0.5 mi. of ditch and a 1700-ft. penstock. No. 2 plant, farther down on Hat creek, is to contain one generating unit of the same type and capacity as that of No. 1. The turbine in No. 2 will be subject to a 195-ft. head of water, which will be delivered by a wooden flume 4700 ft. in length.

The greater development in this region, however is for Pit River Plant No. 1, which is under construction. The powerhouse for this project is on Pit river, a short distance below the mouth of Fall river, and for driving turbines the water of Fall river will be utilized. This will be accomplished by driving a 10,040-ft. tunnel from Fall river to the power-house site on Pit river, obtaining at the latter point a head of 454 ft. A contract for driving this tunnel has been let to F. Rolandi, San Francisco, who has the work in progress. The equipment for this plant will consist of two vertical 40,000-hp. turbines, two 35,000-kv-a. generators, two banks of transformers and other accessory machinery. Construction is in progress, but the plant's completion will not be prior to April, 1922.

A double-pole transmission line, to carry energy at 110,000 volts, is being built from Pit river and Hat creek plants to Cottonwood, 60 mi. southwest; and from Cottonwood south to Cordelia, a distance of 142 mi., the company is constructing a double-circuit line on steel towers to transmit energy at 110,000 volts. Plans also provide for building an 82-mi. transmission line from the Pit river plant by another route to Cottonwood.

On the North Pacific coast important projects are planned or pending, but the reports from this section and from the mountain states are, as yet, incomplete. They will be made the subject of a later article.

Construction in the Central States

In the central section of the country, from Pennsylvania to the Missouri river and north of the Ohio river line, the most noteworthy piece of construction is the building by the Commonwealth Edison Co., Chicago, of the great Calumet generating station on the west side of the Calumet river near the corner of Commercial avenue and East One Hundredth street in South Chicago. This station has been in contemplation for several years, and preliminary building operations were begun in the early part of 1920. It is designed to have an ultimate rating of 180,000 kw., thus ranking among the world's largest generating stations. The plan provides for six turbo-generator units of 30,000 kw. each. Two of these units, one manufactured by the General Electric Co. and one by the Westinghouse Electric & Manufacturing Co., will comprise the initial installation of 60,000 kw. The portion of the plant now under construction will be about 35 to 40% of the whole. The completed building will be about 570 ft. long, and of this the portion now under construction is about 200 ft. long. In its major dimension, as completed, the station will extend in an easterly and westerly direction parallel to East One Hundredth street (extended). The station will really consist of four buildings in one—the switch-house next to the street, the transformer-house, the turbine-room and the boiler-room, the last named surmounted by smoke-stacks 250 ft. high and 18 ft. diam. An interesting feature will be the use of 300-lb. steam pressure, the highest of any of the company's generating stations. Building operations are proceeding steadily and at a satisfactory rate. Foundations are practically completed and the setting of steel for the superstructure is under way. It is hoped to have the first unit or units of this plant in operation before the close of the present year.

Transmission-line construction during the year promises to be mainly such as will be made necessary by the construction of the new Calumet station. It is proposed to lay 33,000-volt underground cables as tie-lines between the existing Fisk street station and the Calumet station. This, of course, will mean considerable conduit work also. To increase the steaming capacity of the older boilers in present generating stations it is planned to enlarge considerably the existing installations of forced-draft stokers.

The company is proceeding to make reactor installations on all its high-tension feeder lines. This is a stabilizing and protective measure. Some additions to substation installations are also contemplated.

In Illinois and Surrounding States.

Out through Illinois and the surrounding states the projects announced for the immediate future are scattering and in many cases details have not been announced for publication, but the following are typical:

The Southern Illinois Light & Power Co., whose headquarters are in St. Louis, has been authorized to issue $715,160 in bonds and $331,882 in stock for the purpose of making betterments to its property, which includes generating stations at Hillsboro, Gillespie, Greenville, Morrisonville, Collinsville, Litchfield, Du Quoin, Mt. Vernon, Sparta, Chester, Pinckneyville, Nashville, Bunker Hill, Lebanon and O'Fallon, with a network of transmission line covering the districts served. Plans are in process of completion and bids will be received about April 1 for the construction of an electric power plant at Freeburg, Ill. Fuller & Beard, Chemical building, St. Louis, Mo., are making the plans.

The Bloomington & Normal Railway & Light Co., Bloomington, Ill., has increased its capital stock from $1,800,000 to $2,900,000 to provide for service extensions and improvements. It is a consolidation of several independent power systems and part of the Illinois Traction System.

For this system as a whole there has already been appropriated, for improvements to be made this year, approximately $3,500,000.

The Beloit Water, Gas & Electric Co., Beloit, Wis., has just secured permission from the County Board to extend its line to Liberty.

The Wisconsin-Minnesota Light & Power Co., with headquarters at Grand Rapids, Mich., plans improving and enlarging its plants. It has applied to the Federal Power Commission for a license to construct a dam and reservoir at the forks of Chippewa river, Sawyer county, Wisconsin, for public utility purposes.

The Oslo Power & Light Co., Manitowoc, Wis., will enlarge its plants, extend its transmission system and make other improvements. The company has in operation two hydroelectric and one steam plant.

The Milwaukee Electric Railway & Light Co., Milwaukee, Wis., will construct new transmission lines to and beyond Franksville, Wis., fed from its present distribution system at Racine, Wis.

The Duluth Edison Electric Co., Duluth, Minn., will expend $165,000 for the construction of a direct transmission line from the Great Northern Co.'s plant at Thomson, Minn., and the building of a new substation in Duluth.

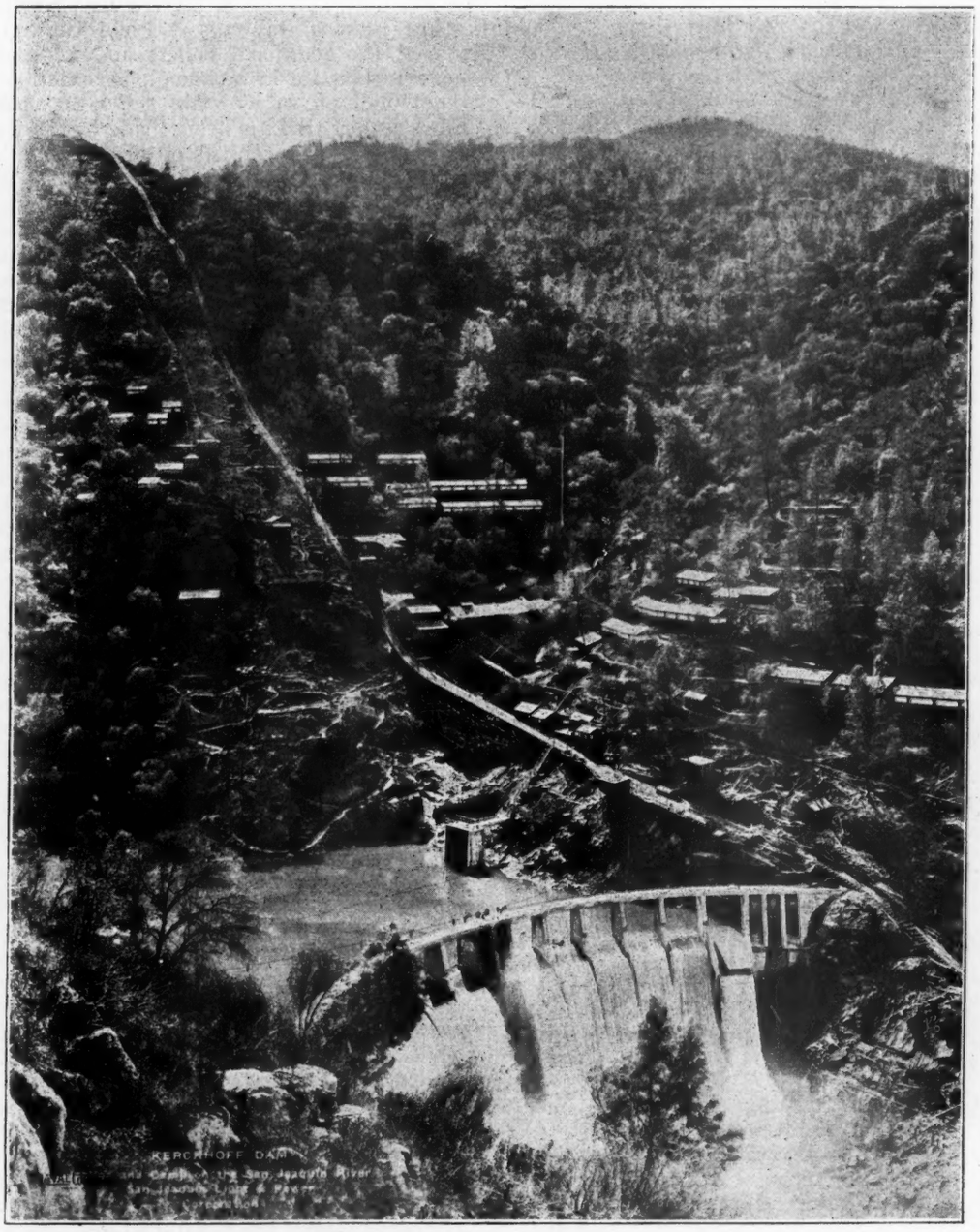
The Nelson Light & Power Co. has been organized at Nelson, Minn., to build an electric power plant and distribution system.

The erection of a transmission line from the electric light plant at Blue Earth, Minn., to supply light and power to Ceylon and Dunnell, Minn., will probably be arranged for this spring.

The Otter Tail Power Co., Fergus Falls, Minn., will put in a transmission line to Rothsay, Minn., to supply that district with current for power and lighting.

In Iowa a chain of hydroelectric properties will be developed by the Iowa Railway & Light Co., Cedar Rapids, on the Cedar river and nearby streams. The company now operates a water-power and steam plant at Cedar Rapids and steam plants at Belle Plaine, Boone, Cedar Rapids, Coon Rapids, Marion, Marshalltown, Nevada, Perry and Toledo. Extensive improvements will be necessitated by the new developments and the tieing in of the entire system.

The Dubuque Electric Co.'s most important work will be an extension to the boiler room and the installation of two 750-hp. boilers with Riley underfeed stokers and a 13-ft. Weber concrete chimney, 265 ft. high. The total estimated cost



Kerckhoff Dam of the San Joaquin Light & Power Corp., in the Canyon of the San Joaquin River; 125 Ft. High, 570 Ft. Long at Top, 20 Gate Openings, Built in 4 Months' Time.

This is one of the recently completed portions of this company's great development project. A full description of the plant and its construction, together with an outline of the important features of energy transmission, is given on pp. 384 to 388 of this issue.

is $225,000. Line extensions will be confined to changes in the present distribution system from 2300-volt to 4000-volt, 3-phase, 3-wire.

The Tri-City Railway & Light Co., Davenport, will make service extensions only.

The Hopkinton Electric Light & Power Co., organized at Hopkinton, Ia., has had plans prepared for the erection of a new power plant.

Other companies throughout the state have important projects under way but not yet announced.

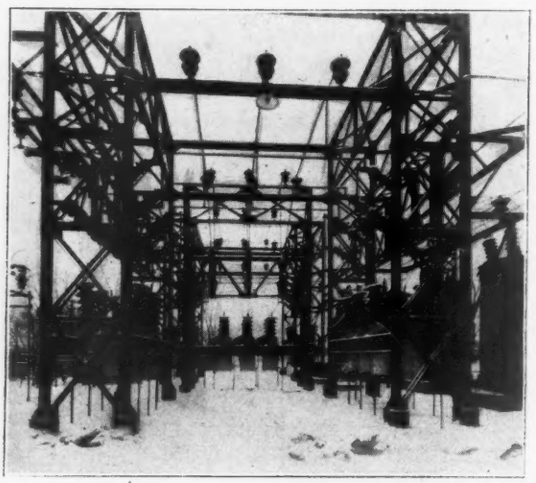
The Nebraska Power Co., Omaha, Nebr., has no unusual extensions planned, but states that the regular additions to its property to take care of the usual growth of the business will amount to about $1,125,000.

The Kansas City Light & Power Co., Kansas City, Mo., has perfected plans for a bond issue to total $10,000,000, the proceeds to be used in part for extensions to its electric generating plants which now total about 60,000 kw., and improvements to be made throughout its system.

The Excelsior Springs Water, Gas & Electric Co., Excelsior Springs, Mo., plans to erect a transmission line to Liberty, Mo.

Plant improvements at Lexington, Liberty and Richmond, and service extensions in the districts traversed by its transmission lines, including Hardin, Henrietta, Orrick, Myrick and Camden, are reported to have been decided upon by the Missouri Gas & Electric Service Co., Lexington, Mo., which is a subsidiary of the Middle West Utilities Co., Chicago.

Extensions and improvements totaling over $1,500,000 are to be provided for this year by the



Typical High-Tension Outdoor Substation.

Empire District Electric Co., Joplin, Mo., a subsidiary of the Cities Service Co. operated by Henry L. Doherty & Co., New York.

Numerous other projects throughout the state are pending and the details will soon be released for publication.

The Cheboygan Electric Light & Power Co.'s dam near Pellston, Mich., will be entirely rebuilt. Plans include the installation of waterwheels and electric generating equipment. The present plant at the dam will be discarded.

The Consumers Power Co., Grand Rapids, Mich., has plans under way for the erection of a power plant which is estimated to cost $400,000. It also proposes the construction of one or two power dams on the Manistee or Au Sable rivers during the summer.

In Indiana, the Indiana General Service Co. will put in operation two new 500-hp. boilers and a 6250-kv-a. steam turbine at its main generating plant in Marion, and will make other extensions and improvements. This company is controlled by the American Gas & Electric Co., New York.

The Indiana Railways & Light Co. has contracted for additional boilers and a 5000-kv-a. steam turbine for its Kokomo power station.

An addition to its main generating plant at Edwardsport, Ind., is being made by the Indiana Power Co. This consists of an extension of the main building, 100 by 140 ft., in which will be housed two 5000-kw. generators and four 750-hp. boilers. Two of the boilers for the addition are now on the ground, and a portion of the turbine equipment for one of the units. The second generator unit for this addition has not yet been purchased. The general contractor on this improvement is the Utilities Development Corporation, Chicago, Ill. On transmission lines there will be some double circuiting done and some minor extensions. The company's transmission line trunk system is all 33,000-volt, 3-phase, 60-cycle. It has a large power business with coal mines, and also sells wholesale to several other utilities in addition to the usual lighting and power business of the cities and towns in the territory served so that further extensions will be necessitated.

The Union Traction Co. of Indiana, operating from Anderson, will make only necessary service extensions.

With Tippecanoe, Ind., as its headquarters, the Tippecanoe Power Co., recently organized, is planning to begin work by or before summer on a series of hydroelectric projects to supply districts in that section of the state with electric light and power. A reported initial expenditure of $3,000,000 is involved.

Tabulation of Ohio Improvements.

First in importance in Ohio are the extensions to be made by the Union Gas & Electric Co., Cincinnati. The largest of these comprises the installation in the West End power station of a fourth 30,000-kw. steam turbine complete with condenser, boilers, switchboard and switching equipment, and completion of construction and equipment of a new direct-current substation in downtown Cincinnati. The equipment of the station will consist of an 8680-ampere-hour, 157-tank storage battery and two 3500-kv-a. rotary converters, with necessary transformers, bus structure, switches and switching equipment.

This company has a contract with the Cincinnati Traction Co. to supply them beginning this year with a connected load of approximately 17,000 kw., having a minimum guaranteed demand of 10,000 kw. To connect their substations with the Union Gas & Electric Co.'s lines will necessitate the following new construction work:

(a) "Building of approximately 2 mi. of 3-phase, 13,200-volt overhead transmission line.

(b) "Building of approximately 2 mi. of 3-phase, 13,200-volt underground transmission line.

(c) "Installing in present duct system, approxi-

mately 10 mi., of three conductor 13,200-volt cables."

The company also plans on building a transmission line to interconnect at the Indiana-Ohio state line with a transmission line from Hagerstown, Ind.; construction to consist of approximately:

(a) "0.5 mi. of underground 3-phase, 13,200-volt transmission line.

(b) "4 mi. of new 3-phase, 13,200-volt transmission line.

(c) "A 13,200/33,000-volt step-up transformer station.

(d) "Stringing 12 mi. of 3-phase, 33,000-volt transmission line on poles of the present transmission line to Lawrenceburg and Aurora, Ind.

"Building of a new 3-phase, 13,200-volt tie line between the West End power station and the Newport powerhouse to consist of approximately:

(a) "1.5 mi. of 13,200-volt, 3-phase, underground line.

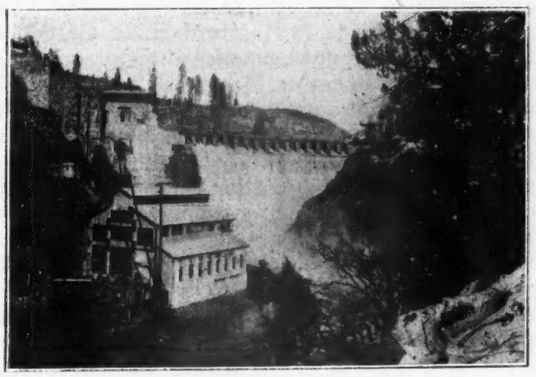
(b) "2 mi. of 13,200-volt overhead line.

"Building approximately 3 mi. of single-phase, 33,000-volt line, and 15 mi. of single-phase, 2400-volt distribution to supply current to the villages of Deer Park, Montgomery, Blue Ash, Beechwood and Rossmoyne, O."

In the cost of this work $2,500,000 is represented by the addition to the West End power station alone.

The Richland Public Service Co., Mansfield, O., was forehanded in providing for this year's business, having put in a 10,000-kv-a. steam-turbine unit and 12 mi. of 66,000-volt line, with two new substations, so 1921 work will be confined to service extensions necessary for distribution of the increased output.

The Springfield Light, Heat & Power Co., Springfield, O., will make improvements which will cost about $200,000. Plans include construction work, betterments to the distribution system and installation of automatic voltage regulators.



Copoc Hydroelectric Plant, California-Oregon Power Co., on Klamath River, Calif.

Expenditures now authorized for the properties of Henry L. Doherty & Co. during the first six months of the present year amount to approximately $3,000,000, the bulk of which is for extensions to existing distribution systems and for improvements of various kinds. The work includes the completion of a 5000-kw. turbine with additional boiler capacity at the plant of the Massillon (O.) Gas & Electric Co., the completion of additional boiler installations in the plant of the Trumbull Public Service Co., Warren, O., and similar work in various plants in the West.

A great deal of other work will be done this year throughout Ohio, details to be given later. Delays in completion of financing have held up the official announcement of many important projects.

Eastern Developments

In the East the most important work planned is that of the United Electric Light & Power Co., New York City, which now has under construction a new generating plant known as the Hell Gate station, at 132nd to 134th streets and the East river, Borough of Manhattan. This station when completed will be one of the largest generating stations in the world, with a rated capacity of 280,000 kw. The foundations, water front improvements, etc., are now well under way and steel erection is about to begin. The plant will be unique in many respects. The turbine room will be parallel and adjacent to the river, so that it will be possible to eliminate the suction tunnel, individual suction pipes being carried through the east foundation wall into the screen basins back of the bulkhead line. The boiler house will be next to the turbine room, between the electrical galleries and the turbine room, and will be separated from the electrical galleries by a narrow passage. The initial installation of generating equipment will consist of two 35,000-kw., 25-cycle, 3-phase, 11,000-volt General Electric turbogenerators and two 35,000-kw., 60-cycle, 3-phase, 15,200-volt Westinghouse turbogenerators.

Coal will be unloaded from barges or ocean-going vessels by means of three traveling towers installed on a trestle adjoining the bulkhead. The boiler house will accommodate twenty-four 1890-hp. water-tube boilers, 12 boiler units being installed for the first four turbines. The condensers for each unit will have 50,000 sq. ft. of surface.

Further and more complete detail will be available concerning the features of this station in the near future. The ultimate capital expenditure required for this station with its full capacity and equipment will be about $24,000,000.

In the Sherman Creek station the final unit for which this station was designed (eight units in all) is now being installed and will be put into service during the early part of the year. Nine additional 650-hp. boilers, together with the necessary superheaters, stokers, etc., will be installed in this plant during the current year.

An additional substation located at 115-17 West 97th street, made necessary by the increased demand upon the distributing system, is now being erected. The operation of this station is scheduled for the fall of 1921. Four incoming 15,000 and 12 outgoing 3000-volt feeders will be installed to meet the demands to be made upon this substation, which will supply that portion of Manhattan Island bounded by 76th street west of Central Park and 87th street east of Central Park, and 120th street west of Lenox avenue and 115th street east of Lenox avenue. With

the completion of this station the company will have in operation seven substations, including the West Farms station located in the Bronx, devoted exclusively to the supply of energy to the New York, New Haven & Hartford R. R. Co. The United company now supplies directly upwards of 70,000 consumers on Manhattan Island, in addition to which it supplies service in parallel with the Cos Cob station of the New York, New Haven & Hartford R. R. Co. for the operation of that system, and high-tension service to the Boroughs of Queens and Bronx and a large part of Westchester county for allied companies. As a whole it furnishes service over an area of 620 sq. mi. from the Battery to Peekskill, the 60-cycle system now extending as far north as that point, 30 mi. from the Sherman Creek plant, as well as service to the Boroughs of Bronx and Queen and Westchester county.

Other activity in the vicinity of New York City and through the state is evidenced by the following items:

The Kings County Lighting Co., Brooklyn, N. Y., has filed notice of increase in capital from $2,000,000 to $4,000,000 for proposed extensions and betterments.

The Tonawanda Power Co., North Tonawanda, N. Y., is planning a considerable extension of its lines. It is proposed to commence the work early in the spring, and assurances have been given the city officials that the extensions will be carried out as planned.

The Corning Light & Power Corp., Corning, N. Y., has been granted permission by the Public Service Commission to issue bonds, the proceeds to be used for extensions and improvements in its system.

The Half Moon Light, Heat & Power Co., Mechanicsville, N. Y., has increased its capital from $200,000 to $300,000 for proposed expansion.

The Mountaindale Electric Light & Power Co., Mountaindale, N. Y., has been incorporated to operate an electric light and power plant.

The Rockland Light & Power Co., Orangetown, N. Y., has filed notice of increase in capital from $1,300,000 to $1,600,000 for proposed expansions.

The Carmel Light & Power Co., Carmel, N. Y., has been incorporated to operate a light and power system there and in other parts of Putnam county.

The Western New York Utilities Co., Medina, N. Y., will enter upon the construction of a power dam, the third in its system, to be built northeast of that place. It is now operated partly on current from the lines of the Niagara, Lockport & Ontario Power Co.

The Nassau & Suffolk Lighting Co., Brooklyn, N. Y., has arranged for a bond issue of $436,000 for proposed extensions and betterment work and general operations. Headquarters of the company are at 149 Broadway, New York.

The Northern New York Utilities, Inc., Watertown, N. Y., is planning to extend its transmission lines to Alexandria and Theresa, N. Y.

The Mountaindale Electric Light & Power Co., Mountaindale, N. Y., and the Antwerp Light & Power Co., Antwerp, N. Y., have made application to the Public Service Commision for permission to build and operate electric power plants.

The Iroquois Utilities, Inc., Syracuse, N. Y., will put out a bond issue, the proceeds of which are to be used mainly in the construction of a hydroelectric plant on Cattaraugus creek at Gowanda, N. Y.

The New York & Ontario Power Co., Waddington, N. Y., is maturing plans for the development of hydroelectric power, approximately 20,000 kw., at a site on the south channel of the St. Lawrence river, near Ogdensburg, N. Y. Application has been made to the Federal Power Commission for permission to construct a dam at that point.

The Rockland Light & Power Co., Nyack, N. Y., which is under the mangement of Chas. H. Tenny & Co., Boston, Mass., is arranging for funds with which to provide for extensive additions and improvements to its system. Power plants are now operated in Orangeburg and Hillburn, N. Y.

A new substation and distributing system will be put in at Boston, N. Y., by the Depew & Lancaster Light, Power & Conduit Co., Lancaster, N. Y., which takes current from the lines of the Niagara & Erie Power Co.

The Half Moon Light, Heat & Power Co., Mechanicsville, N. Y., has made provision for extensive additions to its system which is now operated on current purchased from the Adirondack Electric Power Corp., Glens Falls, N. Y.

The Adirondack Power & Lighting Co., Amsterdam, N. Y., has broken ground for the construction of its proposed hydroelectric power plant on the Mohawk river, Clifton Park, near Albany. The power station with machinery is estimated to cost in excess of $2,000,000. The company recently increased its capital from $13,800,000 to $23,100,000.

The Millville Electric Light Co., Millville, N. J., is planning the construction of an addition to its power plant to cost about $500,000, with generating and operating equipment.

The New Jersey Power & Light Co., Dover, N. J., has completed the construction of a new power line from Aparta Junction to Hamburg, operating at 33,000 volts. The transmission system will be used to furnish power to a number of industrial plants in this section, as well as for commercial and residential lighting service in certain districts. The company has rebuilt a large portion of its lines in the Bernardsville section, as well as portions of the primary and secondary system in the vicinity of Hercules Park, Kenvil, N. J.

W. S. Barstow & Co., New York City, who supervise the management of the properties controlled by the General Gas & Electric Co., including the Pennsylvania Utilities Co., Easton, Pa., and the Eastern Pennsylvania Power Co. of New Jersey, Phillipsburg, N. J.; Neversink Mountain Railway Co., Reading, Pa.; Oley Valley Railway Co., Reading, Pa.; Metropolitan Edison Co., Reading, Pa.; Sayre Electric Co., Sayre, Pa.; Binghamton Light, Heat & Power Co., Binghamton, N. Y.; New Jersey Power & Light Co., Dover, N. J.; Rutland Railway, Light & Power Co., Rutland, Vt.; Vermont Hydro-Electric Corp., Rutland, Vt.; West Virginia Traction & Electric Co., Wheeling, W. Va.; City Railway Co., Wheeling, W. Va.; Sandusky Gas & Electric Co., Sandusky, O.; Northwestern Ohio Railway & Power

Co., Oak Harbor, O.; Port Clinton Electric Light & Power Co., Port Clinton, O., and the Eastern Utilities Coal Co., Lost Creek, W. Va., have outlined a construction policy ranging between a minimum of $1,000,000 and a maximum of about $4,000,000 or more, which represents their usual yearly construction program. This company is very careful with its commitments and its initial budget for any year only includes those things which can readily be financed at once. As time goes on and conditions improve, or normal operating requirements dictate, the budget is enlarged, looking ahead about six months. With a radical improvement in the money market, this company may lay out a program involving large construction to cover a period of about two years.

Proposed Work in New England.

In Massachusetts a noteworthy addition, of 20,000-kw. capacity, is being made to its generating plant by the New Bedford Gas & Edison Light Co. A wharf extension, for storage for about 50,000 tons of coal, is also being built.

The Lowell Electric Light Corp., Lowell, Mass., has arranged for a stock issue of $1,176,400, the proceeds to be used in part for the completion of the addition to the company's power plant, to provide for an increase of about 12,500 kw.

The Edison Electric Illuminating Co. of Boston has not planned any large work for the present season, but will make the usual extensions to its distribution system, such as have usually been provided from year to year to meet the growing requirements of the system. The same is true of the Edison Electric Illuminating Co. of Brockton, Mass.

The Gardner Electric Light Co., Gardiner, Mass., will confine itself during the fore part of the year to expenditures for general plant maintenance and repairs.

The Amesbury Electric Light Co., Amesbury, Mass., will expend $60,000 in extensions to its system, and the Union Light & Power Co., Franklin, Mass., has appropriated $150,000 for the same purpose.

The Beverly Gas & Electric Co., Beverly, Mass., has arranged to increase its capital stock from $687,000 to $825,000. The proceeds will be used for extensions and improvements in plant and system.

The Connecticut River Co., Hartford, Conn., is arranging for the construction of a new hydroelectric generating plant on Kings Island in the Connecticut river, near Windsor Locks, Conn. The proposed plant will have a capacity of about 32,000 hp., with dam to be constructed 30 ft. high and about 2000 ft. long. Application for permission to build the plant has been made to the Federal Power Commission.

Activities Planned in Pennsylvania.

A number of public utilities have made application to the Public Service Commission of Pennsylvania for permission to issue securities for proposed new construction, extensions and improvements, as well as for general operations. These include the West Penn Power Co., Pittsburgh; Dillsburg Light, Heat & Power Co., Dillsburg; Lower Chanceford Electric Light, Heat & Power Co., Sunnyburn; Mt. Carmel Township Electric Co., Mt. Carmel; Panther Valley Electric Co., Lansford, and Shenango Valley Traction Co., Sharon, Pa. Of these it is reported that an increased stock issue of $2,500,000 will be provided for by the West Penn Power Co. and the proceeds used chiefly for improvements to its system.

The Chester Valley Electric Co., Coatesville, Pa., states: "We are at the present time building a second 13,200-volt line from our South Hill substation, located about a mile south of Coatesville, to the substation of the Lukens Steel Co., which is also about a mile from the substation. We are also building a tap from another 13,200-volt line to the S. J. Arohsohn silk mill in Coatesville, which has just been enlarged and about 250 additional horsepower in motors installed.

"In addition to the above, we are making a short extension to another one of our 13,200-volt lines in order to supply power to the scrap yards of the Perry Buxton Doane Co. below Modena, and we are also making a short extension to the same line in order to supply power to the slag-crushing plant of the Duquesne Slag & Product Co. which is now in the process of erection above Modena. We are also stringing additional 2200-volt feeders from our power plant in Coatesville to the new plant of Breuninger Bros., a distance of about 4000 ft."

The Duquesne Light Co., Pittsburgh, Pa., says: "We have under contemplation for the coming year the construction of several new substations, together with their tie-in lines, at an estimated cost of approximately $2,500,000.

"In addition, if the general business situation improves, we will proceed with the installing of additional generating capacity in the new Colfax station, together with tie-in lines for the same. If such work is done, the cost of same will be $6,000,000 to $7,000,000."

The Harrisburg Light & Power Co., Harrisburg, Pa., is providing an appropriation of $300,000 to be used for proposed extensions and improvements in its electric plant and system. The company plans the installation of new machinery and certain betterments to relieve the power shortage in its territory.

The Wilkes-Barre Co., Wilkesbarre, Pa., is working on the installation of one 6000-kw. General Electric turbine and two 600-hp. Babcock & Wilcox boilers with additional auxiliary equipment, including a cement stack 10 ft. diam. and 200 ft. high—the total cost of which will be about $500,000. Another improvement will be the extension of the Wilkes-Barre Co.'s 11,000-volt line to the southern end of the city where a substation is to be erected.

The Penn Central Light & Power Co., Lewiston, Pa., is also constructing a new transmission line.

The Middleburg Light, Heat & Power Co., Middleburg, Pa., (Juniata Public Service Co.) is arranging for a merger of six electric companies, operating in Perry, Snyder and Union counties, with its organization, and will make improvements to them as the service requirements dictate.

The Metropolitan Edison Co., Reading, Pa., has made application to the Public Service Commission for permission to issue bonds, the proceeds of which are to be used for plant extensions.

The Lock Haven Electric Light & Power Co.,

Lock Haven, Pa., will proceed with the erection of its proposed electric power plant, estimated to cost about $300,000, including equipment.

The Mercer County Light, Heat & Power Co., Greenville, Pa., will erect a new high-tension transmission system to furnish power to Stoneboro and Sandy Lake, Pa. This utility is controlled by the Pittsburgh District Electric Co., Boston.

The Penn Public Service Corp., Johnstown, Pa., which is a merger of the Citizens Light, Heat & Power Co. of Pennsylvania, the Penn Public Service Co. and the Penn Electric Service Co., with power plants at Johnstown, Phillipsburg, Rockwood, Somerset, Indiana and Clearfield, has a large new generating station under construction at Seward, Pa., as shown by the accompanying illustration. This was designed by Dwight P. Robinson & Co., New York, who are also in charge of the construction.

The Southern and Border States

The Consolidated Gas, Electric Light & Power Co., Baltimore, Md., has arranged for a bond issue of $5,000,000, the bulk of the proceeds to be used during the coming year for electric generating plant extensions and line betterments, including transmission and distributing system. The company has plans under way for the erection of an addition to its plant on Front street in Baltimore, as well as for a plant extension at Madison and Graves streets. A power plant at Dundalk is reported to be projected. Some new work will also be undertaken in Baltimore by the United Railways & Electric Co.

W. W. Hepburn, 1417 Pennsylvania building, Philadelphia, is at the head of a project to construct a hydroelectric power plant in the vicinity of Schuyler, Va. Francis R. Weller, Hibbs building, Washington, D. C., is engineer for the project.

The Craddock Utilities Co. has been incorporated at Craddock, Va., and will erect a power plant.

The Weyers Cave Light & Power Co., recently organized at Weyers Cave, Va., is planning for the operation of a hydroelectric power plant on the Shenandoah river.

At Martinsburg, W. Va., the Potomac Light & Power Co. has provided for new equipment to replace a recent loss by fire, and will make needed service betterments.

The Meadow Creek Power Co., Charleston, W. Va., has been incorporated to operate an electric light and power system in Fayette and Greenbrier counties.

The Southern Power Co., Charlotte, N. C., has plans under way for the erection of a hydroelectric power plant on the Catawba river, with initial capacity of about 35,000-hp. The proposed plant, with transmission system, is estimated to cost in excess of $5,000,000.

The Southern Utilities Co., operating electric (and ice) plants in Florida and Georgia, will make extensive improvements, including the addition of a 300-hp. Stirling boiler and a 1500-kv-a. steam turbine at West Palm Beach, Fla., and a 600-kv-a. steam turbine at Sanford, Fla.

The Kentucky Public Service Co., Bowling Green, Ky., having electric plants in Kentucky and Tennessee, will put in operation at Clarksville, Tenn., a complete new steam turbine station of 500 kw.

Interests identified with a large northern power company are reported to contemplate the erection of an electric plant in the Monroe (La.) gas fields.

The Irvine Light Co., Irvine, Ky., is planning extensions to its power plant.

The Alabama Power Co., Birmingham, it is reported, will expend $100,000 to improve and extend the Gadsden street railway, and also plans the construction of a new transmission line connecting with the system of the Georgia Railway & Power Co. of Atlanta, Ga.

The Georgia Railway & Power Co., Atlanta, Ga., will install additional power equipment and make improvements over its entire system.

The Carolina Power & Light Co., Raleigh, N. C., which operates steam plants at Raleigh, Henderson and Goldsboro and a hydroelectric plant at Buckhorn Falls, will make additions to powerhouse and other equipment.

The Charleston Consolidated Railway, Gas & Electric Co., Charleston, S. C., has filed notice of increase in capital from $5,000,000 to $5,500,000 to provide for extensions to the property and new equipment.

The Paducah Electric Co., Paducah, Ky., is planning for the immediate erection of an addition to its power plant, with remodeling of the present structure. A new turbogenerator will be installed, as well as switchboard and considerable other equipment. The work is estimated to cost about $200,000. Line extensions and other improvements will be made to cost about $50,000. Stone & Webster, Boston, are engineers for the project.

Some important projects reported from local points in the South will not be referred to because of lack of confirmation from controlling interests in the North, but will be mentioned later when officially announced.

In the Southwest

In the Southwest a typical example of the progressive development of many important systems is furnished by the plans of the Oklahoma Gas & Electric Co., which is the largest utility of its kind in Oklahoma, serving 30 cities and towns. The most important improvement in 1921 will be a new power station located on the west bank of the Arkansas river about 2 mi. south of Jenks, on the Midland Valley Railway. The building is to be a modern fireproof structure of brick, concrete and steel, constructed with a view to future enlargement. It is the first of several new power plants which the company proposes to erect in various parts of the state, and, when completed,

will mean an increase of 38% to the present capacity of the system.

Duplicate 63,000-volt transmission lines will extend from the new power station to separate junction points with the present main transmission system connecting Muskogee, Drumright, Sapulpa and intervening towns.

Rehabilitation of the system in the town of Bristow, a property acquired some 2 yrs. ago, will be completed shortly. The line to Sand Springs is entirely finished with the exception of the 4500-kv-a. substation; the distributing systems in the towns of El Reno, Hennessey and Waukomis are being rebuilt; the system in Muskogee is undergoing extensive alterations and additions, and in all of the other towns served the year 1921 will see numerous changes and improvements. The Muskogee ice plant, run in connection with the power plant, will be overhauled and new equipment installed where needed. Continued improvements at the Oklahoma City central station will be made. It is also possible that the construction program will include installation of the necessary lines and equipment to provide light and power for a number of municipalities desirous of securing service. The company states in this connection:

"We maintain what we believe to be a broad policy concerning line extensions, and during the coming year this policy will be continued in so far as economic conditions will permit. Extensions will be run where the estimated earnings will pay cost of operation, interest and depreciation; where earnings are not sufficient to pay these charges the customer will be asked to make certain proportionate advances of costs."

The Arkansas Hydroelectric Co. is reported to have arranged for an increase in capital from $500,000 to $8,000,000. Plans are stated to have been prepared by the J. E. Sirrine Co., engineers, Greenville, S. C., for the construction of a hydroelectric plant on the Little Red river in the vicinity of Higdin. It is proposed to inaugurate construction this spring.

The Garland Hydro-Electric Power Co., Little Rock, Ark., has applied to the Federal Power Commission for a license to construct two dams and reservoirs and one powerhouse on the Ouachita river near the boundary between Montgomery and Garland counties, Arkansas, for public utility purposes.

Both of the above appear to be new companies.

The Mammoth Springs Electric Light & Power Co., Mammoth Springs, Ark., will extend its transmission lines to Hardy and vicinity. It now supplies service to a total of five towns in Arkansas and Missouri.

The Arkansas Light & Power Co., Pine Bluff, Ark., is planning the erection of a new steam plant of 40,000-kw. minimum capacity at Russellville, Ark., and the construction of an additional hydroelectric plant on the Ouachita river. New high-tension lines will be strung over a wide area, including a 45-mi. line to Malvern, and various local improvements entered upon.

The San Antonio Public Service Co., San Antonio, Tex., is increasing its capital from $4,700,000 to $7,000,000. Additional machinery will be installed, and $250,000 expended on improvements in its power plant alone.

The Snyder Utilities Co., Snyder, Tex., has plans under way for extensions and improvements in its electric power plant at that place.

The Dallas Power & Light Co., Dallas, Tex., has been granted permission by the Board of Commissioners to install three new power feeders at its main station and three at its East Dallas substation.

The Roby Water & Light Co., Roby, Tex., has been organized and will construct a power plant and 4.5 mi. of transmission system.

A new generating plant is to be built at Pecos, Tex., by the Pecos Power & Light Co., recently organized.

The Texas Utilities Co., Plainview, Tex., which operates power plants at Plainview and Lubbock, Tex., and is controlled by the Light & Development Co., St. Louis, will build new transmission lines to give service to adjacent communities.

American Plants Overseas and in Mexico.

In the possessions of the United States overseas the most important plant planned is an addition to be erected by the J. G. White Engineering Corp. for the Manila Electric Co., Manila, P. I., consisting of a 5000-kw. steam turbine, with new coal storage and coal-handling apparatus and increased boiler capacity.

Important improvements and additions are to be made to the hydroelectric plants and power transmission system of the Guanajuato Light & Power Co., Guanajuato, Mexico. This company has been supplying electric power for the mines and ore reduction mills of the Guanajuato district for many years. Its transmission lines also extend to industrial centers throughout the states of Guanajuato and Jalisco. It plans to increase the capacity of its hydroelectric plants and to extend its transmission lines to other mining districts and industrial centers. Plans have also been adopted by the Dolores Mines Co., an American corporation, to construct a large electric power plant at Madera, State of Chihuahua.

The above review, which does not pretend to be in the least exhaustive, but gives typical examples of work, both large and of moderate size, to be entered upon in various sections of the country, has been compiled from letters, reports and conversations. To a considerable extent it reproduces the language of the informants. Many of the most important projects outlined for this year cannot, however, be referred to at all, as either official confirmation is lacking or the request has been made that it be not used at present.

The geographical distribution of new projects and extensions or improvements also shows that, while the utilities in some sections are taking due advantage of the increased popular support brought about by the great work of the National Electric Light Association, in others they have not done so. Possibly this is a feature of the situation deserving the attention of the various geographic divisions of the association. Anything that can be done to stimulate further activity will be of enormous value to the industry, and it is just as much to the advantage of manufacturers, contractor-dealers, power users and the public generally, as it is to that of the utilities, to make this year the period of greatest construction, replacement and improvement that the country has ever seen.

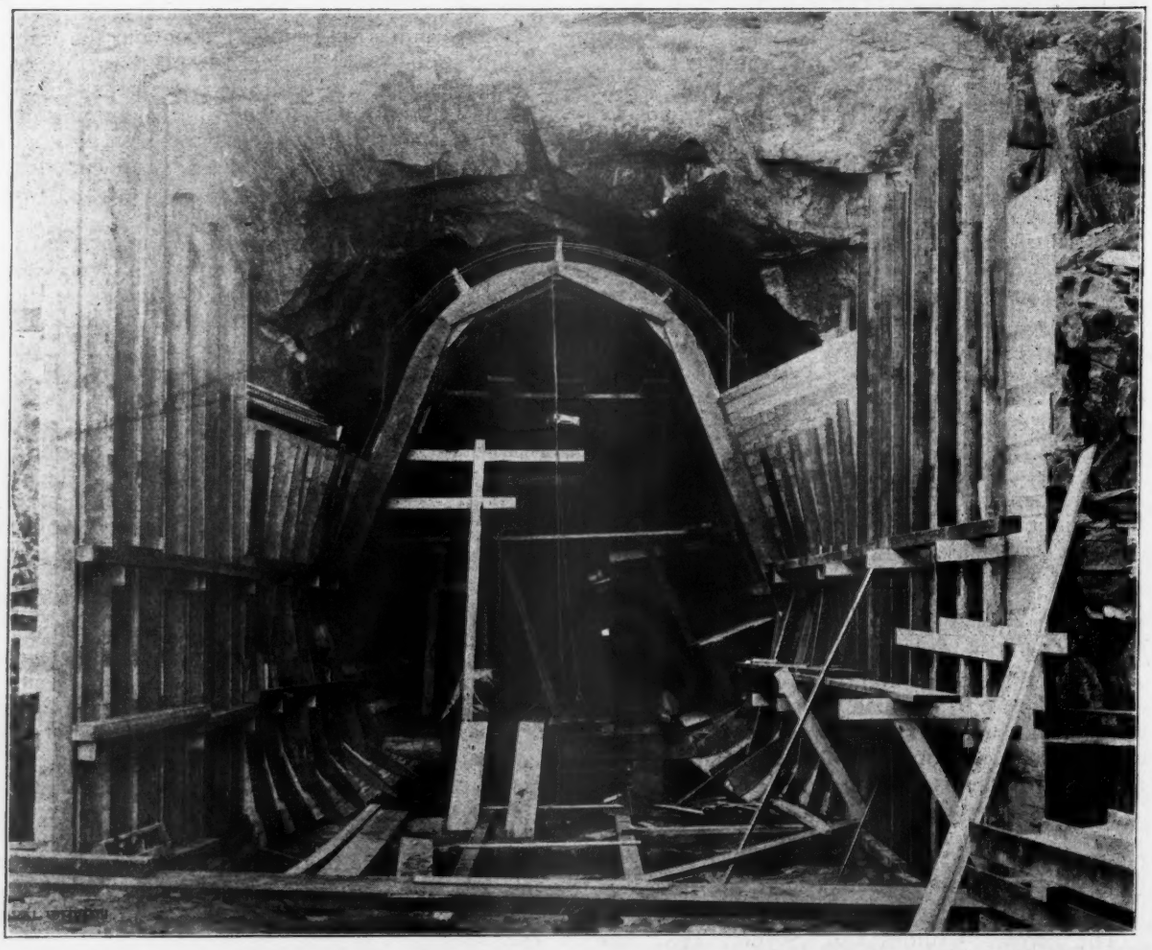
Kerckhoff Hydroelectric Project in California

Brief Details of Dam Construction, Tunnel Driving and Power-Plant Equipment—Electricity Furnishes Power for Construction Work—Four Outdoor Substations Being Installed and Equipped

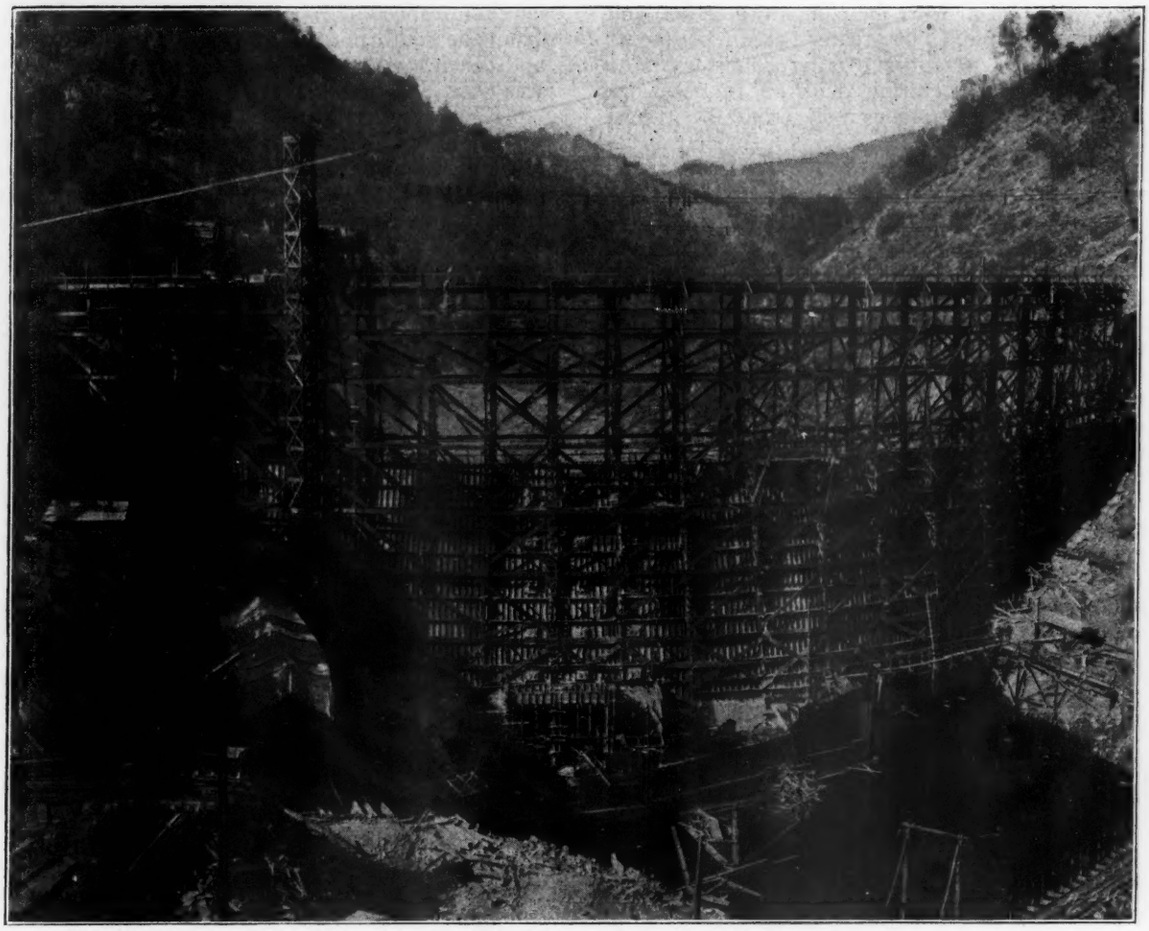
By W. A. SCOTT

The Kerckhoff hydroelectric project of the San Joaquin Light & Power Corp., Fresno, Cal., was begun in May, 1919, and completed in August, 1920. The project comprised the construction of a reinforced-concrete dam, the driving of 17,000 ft. of 18 by 18-ft. tunnel, the installation of three steel penstocks 960 ft. in length, and the building of a power plant of 42,600-kv-a. capacity. The first unit of the new plant was placed in operation Aug. 15, 1920, which was 15 months after the date of beginning work. This development, which is on the San Joaquin river about 40 mi. east of Fresno, gives the corporation a new source of energy whereby an additional capacity of 50,000 hp. is being tied in with its existing power system which serves 125 cities and towns in 10 different counties. The new project represents an expenditure of more than $5,000,000.

Auberry, the nearest railroad point, is 4 mi. east of the dam site which is located at a place where the river makes a sharp bend westerly and from which it takes a circuitous course that describes a half-circle, thence taking again an almost southerly course. A straight line running in a southerly direction from the dam site at the north bend to the power plant represents the course of the 17,000-ft. tunnel. The site selected for the dam is in the river canyon 2 mi. down stream from the company's No. 1 power house and at the foot of a mountain slope on each side. The east slope to which the road approaches from Auberry has a maximum grade of about 92%, there being a vertical distance of 1100 ft. from the river bed to the top of this slope. In order to make possible the delivery of material and equipment to the bed of the canyon for dam construction an inclined surface tramway was built



Entrance to Kerckhoff Tunnel. Gates and a Grid Were In Forms.



Concrete Forms of Kerckhoff Dam, 3 Months After First Bucket of Concrete Was Poured; 26,000 Cu. Yds. of Concrete Was Poured in 3½ Months; 750,000 B. F. of Lumber Entered Into Concrete Forms Shown.

which extended from the top of the east-side slope to the river, a distance of 3000 ft. Electric hoists were utilized in the construction and operation of this tramway.

Transfer of equipment and material across the canyon from the east to the west side was accomplished by two cableways having a 500-ft. span and a capacity of 20 tons. One piece of equipment thus transported was a revolving steam shovel required for removing a heavy bar of sand and gravel from the west bank to clear the way for the foundation of the dam at that end. The lower stratum of this bar was found to be composed of boulders filled in with silt, this serving as the west-end base for a cofferdam that was built across the stream. The cofferdam was constructed of 10 by 10-in. timbers and sheet piling filled in with bags of sand.

Diversion Channel Arranged to Completely Clear the Site of Construction.

A fall of about 8 ft. is made by the river at the dam, and a diversion channel 30 ft. wide and 250 ft. in length was excavated to convey the entire volume of the stream from above the cofferdam to a point below the dam, completely unwatering the bed of the river where excavating and foundation work for the main structure was in progress. The cofferdam was built to a sufficient height to divert as much as 2000 sec. ft. of water through the diversion channel without overflowing the crest in case of a cloud-burst that might result in a sudden flow of such a volume with disastrous results if not diverted.

The main dam was built in the form of an arch on a 200-ft. radius. It has a base width of 35 ft., a height of 104 ft. above the original river bed, and a length of the crest of 570 ft. In the base are three 72-in. sluice gates which are hand-operated from a geared gate stand. At the crest are installed 14 Taintor radial gates measuring 14 by 20 ft. and operated by a motor-driven hoist. The material blasted and excavated for the channel and other work was used as mineral aggregate in the concrete mixers. The crushing and screening plant required for the preparation of this material consisted of two jaw crushers, one 12 by 24-in. and one 9 by 18-in., a set of sand rolls, and the necessary revolving screens for sizing. This equipment, which was all motor operated, was installed at a point on the hillside so that the crushed material could be passed by gravity through chutes to the mixers. The plant, equipment for which was supplied by Allis-Chalmers Co., had the capacity of 25 cu. yds. per hr. The dam construction required about 30,000 cu. yds. of concrete.

Large Amount of Electric Power Utilized in Construction Work.

Motor-driven equipment used in different phases of the construction work made up a total connected load of about 3500 hp. Two substations built for the delivery of the necessary en-

ergy were tied in with the company's 66,000-volt transmission line. The greater part of the power thus provided was for driving compressors to supply air for operating drills in tunnel work and for hauling broken rock from the tunnel headings.

A continuous tunnel 18 by 18 ft. in cross-section and 17,000 ft. in length was built to conduct water from the storage lake above the dam to a forebay near the outlet portal. In putting through this tunnel, driving with air drills proceeded from five headings, as follows: One heading at the upper or north portal; one heading driven southerly from adit No. 1; two headings from adit No. 2; and one heading from the south portal. Work from the north portal was carried on with the company's own force, under direction of E. L. Fox, who put in practice the heading-and-bench method of driving. Here the material was a hard gneiss and the water which came in freely had to be kept out by pumping, but good progress was made. A maximum speed of 12 ft. per day was attained in this work. Tunneling at the other headings was performed under contract. Peter Iverson, San Diego, was awarded the contract for work at adit No. 1; Robinson V. Tinker, Los Angeles, carried on the work from the two headings at adit No. 2, and D. D. De Luca, San Francisco, had the contract for driving at the south portal.

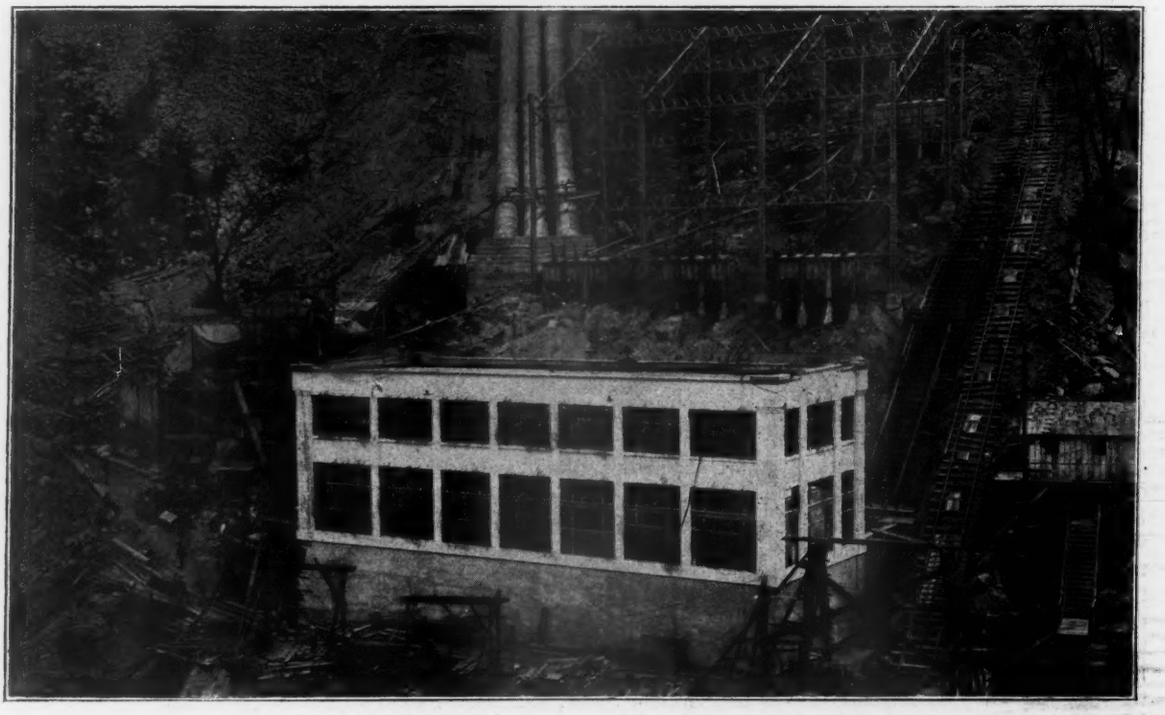
Steam Shovels Used for Mucking Work.

At adit No. 1 the contractor adopted the method of driving against a face that measured the full size of the bore as work progressed. The material at this heading was a coarse-grained seamless granite, and the blasting required 25% more powder than was used at the north portal. The maximum speed made here was 90 ft. in one week. In driving at the two headings at adit No. 2 there was adopted both the heading-and-bench and full-vertical-face methods, and here a maximum speed of 8 ft. per day was made. Work from the south portal proceeded by the heading-and-bench method, and here the maximum speed was 86 ft. in a week.

Progress in tunnel work was greatly hastened by the methods of mucking and haulage. Muck at tunnel headings was loaded into 6-yd. side-dump cars by Marion model 20 and model 40 steam shovels built especially for tunnel work.

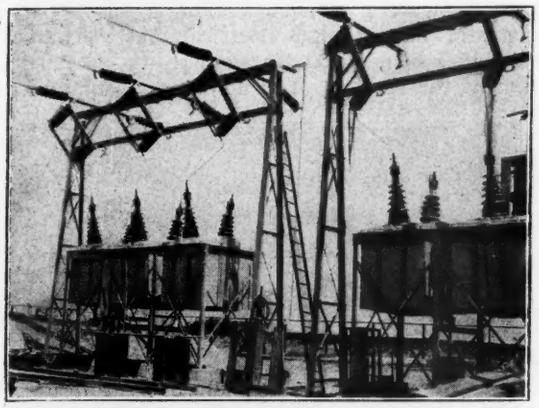
Interior Kerckhoff Tunnel Showing 8500 Ft. of 17,500-Ft. Unlined Tunnel, 18 by 18 Ft., Natural Granite Forming Permanent Walls.

Trains of two to six cars thus loaded were hauled out to the waste dumps by General Electric and Westinghouse 250-volt d-c., electric locomotives supplied with power from overhead trolley lines. For haulage purposes in the tunnels at adit No. 2, however, two storage-battery locomotives were used. The batteries were connected to float on the trolley lines, except when the locomotives were operating within 300 to 600 ft. of the tunnel heading where the lines did not extend.



Power House and Switching Equipment at Kerckhoff Dam When Partially Completed.

One section of the 17,000-ft. tunnel was driven a distance of 8400 ft. through the base of a mountain at a level 1000 ft. below the summit, this section being cut through close-grained granitic rock. During the period of drilling and mucking all tunnel sections were ventilated by means of



High-Tension Switches and Disconnects at Sanger Substation.

motor-driven fans so applied as to draw out the gases after blasting and thereafter to force fresh air into the headings. The area of the tunnel cross-section averages 320 sq. ft. The solid rock formation through which the tunnel was driven made timbering and lining unnecessary. The 60% gelatine dynamite used for blasting was shot off with power taken from a 440-volt circuit. In the charging of 16 holes for a bench blast, about 700 lbs. of this explosive was used.

Forebay Cut in Solid Rock to Form Surge Tank.

The lower terminal of the tunnel opens into a forebay 80 ft. high and 40 ft. diam. at the tunnel-roof level, excavated from solid rock. This forebay is 17 ft. diam. and the spillway is provided into the river through an outlet at the top.

The forebay acts as a surge tank and serves to maintain a constant flow in the tunnel under variable load changes of the generating units. The top of the forebay is practically at the same elevation as that of the Taintor gates at the dam.

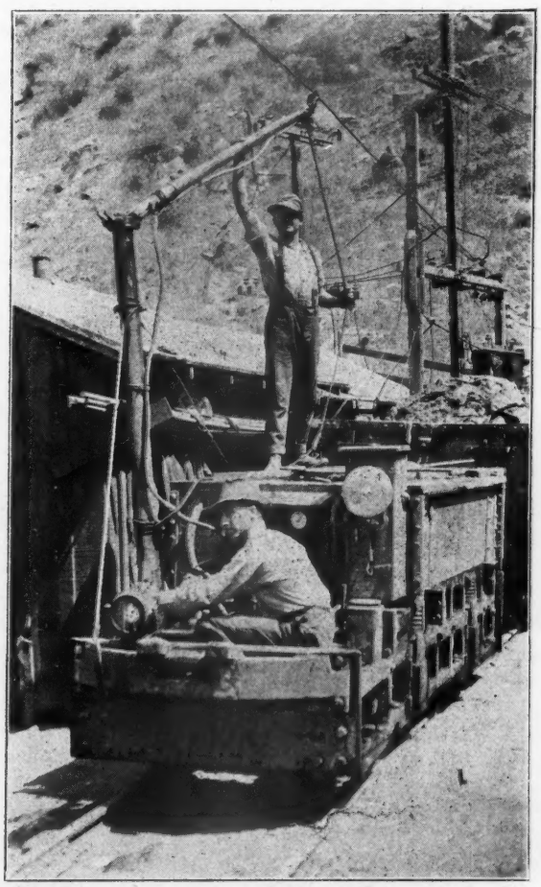
Three parallel steel penstocks, the upper ends of which are concreted into the south portal of the tunnel at the forebay outlet, have a length of 960 ft. and make a descent of 325 ft. to the three short inlet tunnels leading to the turbines in the powerhouse. Each penstock is 8 ft. diam. at the upper end, being reduced to 7 ft. on the lower section. The flow through the penstocks is controlled by three 8-ft. gate valves set just outside the tunnel outlet. Valves and by-passes are electrically operated from the powerhouse switchboard, and at the lower ends of penstocks near their outlets to the turbines are three 84-in. electrically operated butterfly valves designed to withstand full penstock pressure. Air-relief valves are set into the top of each penstock at different locations to admit air when the penstocks have the water drawn out.

Reinforced Concrete Used for Construction of Powerhouse.

The reinforced concrete building in which is housed the three hydroelectric units and their accessory equipment is 36 ft. wide, 100 ft. long, 70 ft. high, and rests upon a bench of rock 40 ft. above the river. A concrete retaining wall 15 ft. high was built around the river-side and ends of the building to protect the generator floor from any possible flood waters. Access to the plant during the construction period was by means of an inclined surface tramway, 1000 ft. in length, which is shown in the view of the power-plant installation.

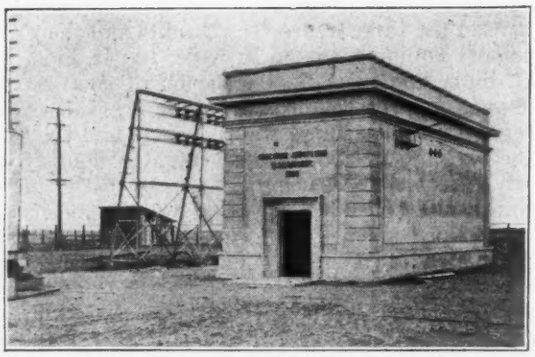
The plant equipment consists, in the main, of three 15,000-hp., vertical, single-runner turbines of the Francis type rated at a speed of 360 r.p.m. Each turbine is direct-connected to a 14,200-kv-a., 6600-volt, 3-phase, 60-cycle, a-c. generator. Each of the exciter units, which are rated at 300 kw. and operate at 250 volts, is driven by a 500-hp. water turbine running at a speed of 900 r.p.m. Additional equipment furnished with the main units includes turbine governors and high-speed pressure regulators. All equipment thus specified was furnished by the Allis-Chalmers Manufacturing Co., Milwaukee.

A building adjacent to the powerhouse contains the switchboard, low-tension busses, rheostats, etc., the high-tension busses, high-tension switches, transformers, etc., being installed outdoors on the hillside above the main building.



Electric Locomotive Used for Haulage in Tunnel Construction.

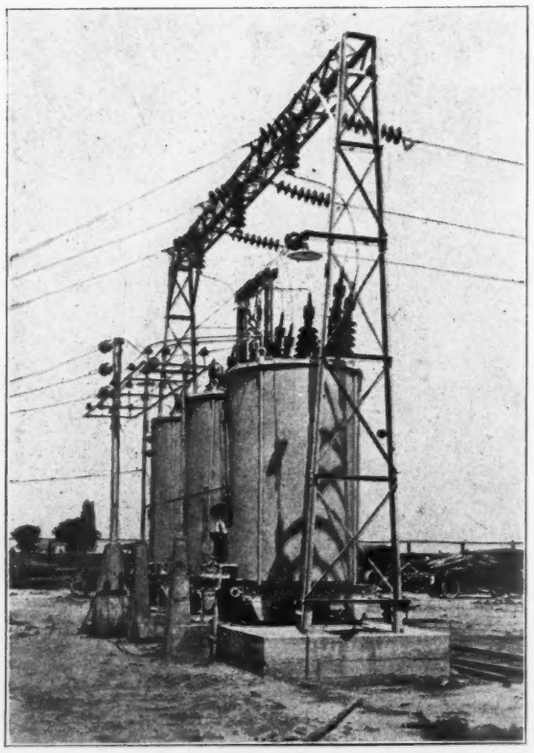
Each generator is connected to a bank of three 5000-kv-a. transformers used to step up the generator voltage from 6600 to 63,510 volts. These



Corcoran Substation—Equipment Housed in Concrete Structure.

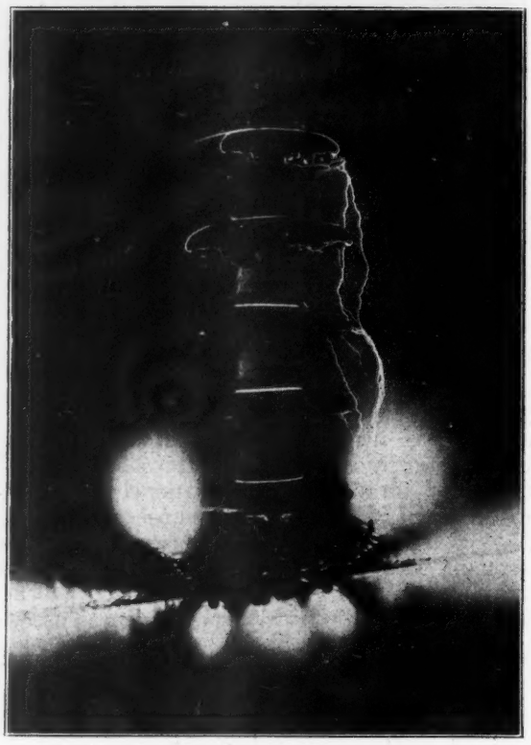
transformers are delta-connected on the generator side and star-connected on the high-tension or line side, thus providing a transmission pressure of 110,000 volts. The high-tension switches, which are of the 4-brake type, were furnished by the Kellman Electric Manufacturing Co., Los Angeles. The transmission line from this plant runs a distance of 125 mi. to McKittrick, near Bakersfield, Cal., single-pole construction being used. Three 266,800-cir. mil aluminum conductors, carried on suspension insulators supported by steel crossarms, from the actual transmission circuit. Wood poles with spacings of 587 ft. are used for line supports. Another line running to Merced, Cal., is now nearly completed.

Substations to take energy from this plant are being built at Merced, Sanger, Corcoran and Wasco. These substations are each being equipped with three 5000-kv-a. transformers to reduce the line voltage from 110,000 to 11,000 volts for distribution. With the exception of the one at Corcoran, these are all outdoor substations.



Bank of Three 5000-Kv-a. Transformers at Sanger Substation.

Considerable attention was given to the insulation of this system, the practice of putting in an insulator rated at 25 kv. per disc being departed from. In the selection of the insulators reliability and fixed charges for interest and depreciation were given attention, a short-spaced insulator having high electrical and mechanical reliability being used throughout for the insulation of the system. The ability of insulators of



Five-Section 10-in. Suspension Insulator on 320,000-Volt 100,000-Cycle Rain Test.

this type to withstand severe service is shown in the accompanying illustration of an insulator on test. In the illustration a considerably smaller insulator is shown on a high-frequency test at 320,000 volts. Under these conditions the arcing-over voltage of the insulator has approximately the same value for wet as well as dry conditions. The illustration shows the insulator flashing over wet, the stress being equivalent to a line voltage of over 500,000. The breakdown of the air along the conductor and the ability of a small insulator to withstand this abnormal voltage is indeed interesting in view of the large developments contemplated on the coast and elsewhere.

The Kerckhoff dam, it is estimated, will store 8000 acre-feet of water in the lake formed above it.

The personnel of the company's staff, actively identified with this project, is as follows: A. G. Wishon, general manager, San Joaqun Light & Power Co.; R. C. Starr, construction engineer; B. F. Jacobson, designing engineer; H. R. Stevens, electrical engineer; W. A. Whitmire, general superintendent; E. H. Warner, resident engineer; E. L. Fox, general tunnel foreman; J. D. McDougal, dam foreman.

Recent Research in Manufacture of Porcelain Insulators

Thirteenth of a Series* of Articles Giving a Concise Review of the Electric Power Situation—High-Tension Equipment Much Improved by Systematic Study—Routine Tests in Manufacture

By ALFRED STILL

Porcelain is used for line insulators, not because it is an ideal material for the mechanical support of overhead wires which may subject the insulators to very heavy loads, but because no better material appears to be available. It is not always to be depended upon in tension and is liable to develop cracks. Also, if made in large, thick pieces, it is difficult to avoid porosity which naturally is an undesirable feature from the electrical standpoint. A good quality of porcelain will usually stand a stress of 1500 lbs. per sq. in. in tension, but in compression it can withstand 40,000 lbs. per sq. in. Special grades of porcelain are now obtainable with an ultimate strength as high as 12,000 lbs. per sq. in. in tension, and 65,000 lbs. in compression.

Great improvements have lately been made in the manufacture of porcelain line insulators, quite apart from the improvements in design and proportions of the parts which have resulted from a careful study and a better understanding of the flux distribution in the electrostatic field. What is known as the continuous-tunnel kiln is probably largely responsible for the production of a more uniform and reliable product. In the early days when prices were low and competition keen, the manufacturer in his efforts to avoid over-firing, would sometimes produce under-fired units which were slightly porous and, therefore, liable to absorb moisture.

During the last few years manufacturers have devoted a great deal of time to the problem of porosity, and improved methods, together with means of detecting porosity in the finished product, have done much to eliminate this cause of trouble. What is known as the fuchsine-dye test is used by at least one manufacturer to guard against porous insulators leaving the factory. In this test a full-sized unglazed piece is included with each car of 70 insulators that is put in the tunnel kiln, and when the insulators come from the kiln the car is not released until the test piece has been placed under the fuchsine test. On the slightest penetration in this test the carload is rejected. If the sample tests in a satisfactory manner the hardware is then assembled on the insulators and each unit is tested to 5000 lbs. mechanical stress, and after this the units are given a 2-min. flashover test at 200,000 cycles. It is found that this mechanical stressing is not injurious to the insulator, indeed units have been placed under a 9000 lbs. mechanical stress and subjected to a dry flashover at the same time, and the stressing does not appear to injure the dielectric properties of the porcelain if kept below the rupture point.

In order to ensure penetration of the dye in porous porcelain, broken pieces of the porcelain to be tested are placed for 2 hrs. in steam vapor before being dropped into the red fuchsine dye liquid, which is subjected to a pressure of 1000 lbs. while the samples are cooling to the room temperature. This process requires several hours. The samples are then removed and dried, after which they are broken so that the depth of penetration of the dye may be observed. With non-porous porcelain there will be no penetration, but when it is slightly porous there will be streaks of red stain in the fracture. A test to determine porosity at the factory without destroying the units so tested would be a great advance over present methods.

As the result of research and extreme care in manufacture the difficulties due to porosity have been largely overcome during the last few years. Sometimes minute cracks in the finished insulator lead to trouble by permitting absorption of moisture, but the chief cause of trouble with suspension units on the higher voltages is the unequal expansion of parts due to the difference in the coefficients of expansion of porcelain, cement and hardware.

Most Insulator Troubles Due to Temperature Variations.

A study of insulator failures among suspension units of various types manufactured within the last 6 to 8 yrs. shows that the majority of these failures have been due to temperature changes. On an average, about 20% per annum of the insulator units that have passed all factory tests satisfactorily have failed after having been in operation a few years. This is a very large percentage of failures, and it is not to be wondered at that engineers and manufacturers are much concerned over the status of the porcelain line insulator and are sparing no efforts to remedy this condition.

The cause of deterioration and failure appears very rarely to be due to the local concentration of electrical stress, which would result in more failures of the units near the line conductor than elsewhere in the string. It is found on the contrary that the units next to the tower, and also those used in dead-end positions, have a greater rate of depreciation than the units in other positions. Observations made on the Pacific coast indicate that defective top insulations; i. e. the units next

*The first article of this series was published in the July 17, 1920, issue of Electrical Review, subsequent articles appearing in the Aug. 7, Aug. 21, Sept. 4, Sept. 18, Oct. 2, Oct. 16, Nov. 6, Nov. 20, Dec. 4, Dec. 18, Jan. 8, Jan. 22 and Feb. 5 issues.

to the point of attachment on the tower, amounted to about 25% of all defectives found on certain lines under observation, while only 11% of the units next to the line wire were defective. The conclusion naturally drawn from these observations is that these particular units pass through greater periodic changes of temperature than those lower down in the suspension string, which are to some extent protected from the sun by those above them, and they suffer deterioration which ultimately leads to an electrical breakdown, even when the stress in the dielectric is less than in the units that are not subject to such extreme and rapid temperature variations. It is, therefore, what may be called thermal fatigue which is the chief factor in the deterioration of suspension insulators in service.

Electrical puncture may be what puts a particular unit out of service, but this is not due directly to an excessive voltage gradient in the material of the insulator. It is frequently brought about by the unequal expansion of the hardware and the porcelain to which it is cemented, which develops small cracks and starts the trouble. The porcelain itself should be of a kind which will resist sudden changes of temperature. It is now manufactured to withstand alternate immersions in boiling and freezing water without developing cracks, and porcelain bodies have actually been made which can stand being brought to a red heat and then plunged into hot water without developing cracks.

Porcelain insulators used inside of buildings, where they are not subjected to extreme temperature variations and are not so liable to absorb moisture, invariably give better service than those on the outside which are subjected to seasonal and daily temperature changes and alternate dryness and moisture.

Observations made on the Big Creek line in California, which is about 240 mi. long running generally from north to south, show that the percentage of insulators suffering deterioration is dependent upon the climatic conditions in the different zones traversed by the line. Near the coast the humidity is high, then there is a section of mountain and desert, and in some places the line rises to an altitude of 5000 ft., where the winters are cold and damp and the summers hot and dry. The greatest number of defective insulators are found where the climate is unfavorable and where porosity and small cracks developed by temperature changes lead ultimately to electrical break-down. Heavy fogs and light drizzling rains appear to be more objectionable from the point of view of line insulation than heavy rainstorms. In valleys where the temperature is usually more even, the rate of depreciation is found to be less than in mountain and coasthill sections of overhead lines.

Research work is now in progress and it is hoped to develop a temperature-cycle test by which suspension insulators may be submitted in a comparatively short interval of time to an aging effect equivalent to that produced by many years in actual service. Suggested plans for tests at Stanford University by Prof. Ryan and others include the placing of a number of units in two equal groups, one of which will be held at a uniform temperature or where the temperature changes will be very small, while the other group will be subjected to temperature changes ranging from 32 to about 140 deg. F. Some units will be tested in this manner while subjected to a load of about 2500 lbs. There would appear to be no advantage in maintaining high voltage continuously on the units under test, but it is possible that some insulators will be stressed electrically as well as mechanically while under test.

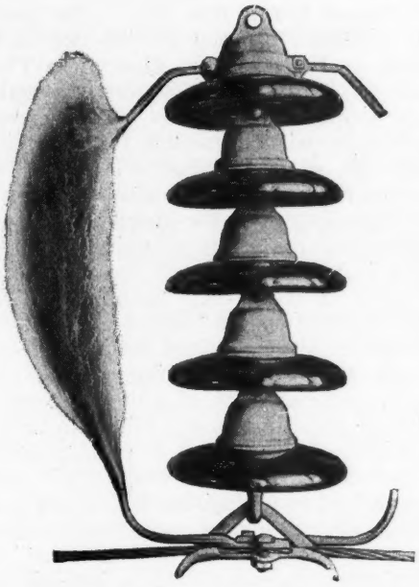
There is no doubt that the solution of the deterioration problem is in good hands and that improvements in design and manufacture will lead to both material and construction being such that insufficient or unreliable line insulation will not be an obstacle to the erection of the contemplated extra-high-voltage lines. A tough nonporous porcelain and a rugged design free so far as possible from expansion troubles will probably be the outcome of the present extensive and thorough investigations. A massive construction has the further advantage that the porcelain is less likely to be injured by the power arc following a flash-over.

Factory Tests of Insulators and Insulator Parts.

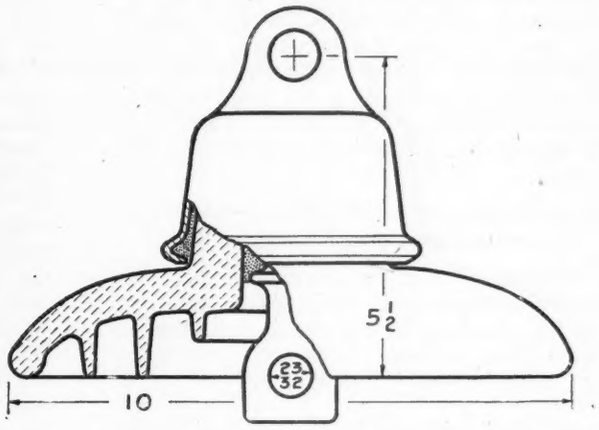
What are known as design tests are those made by the manufacturer to determine the properties of a particular size and shape of insulator. These tests may include mechanical loading to the point of destruction to ensure that the factor of safety is sufficiently high, but the most valuable design tests are probably those which determine the wet and dry flash-over voltage of the insulator. Voltages are usually determined by using the sphere gap, which has certain advantages over the needle gap as generally used in the past until the greater reliability of the sphere gap led to its adoption for the more accurate measurement of high voltages.

When testing for dry flash-over the insulator should be mounted to reproduce as nearly as possible the actual service conditions. This is not always easy to accomplish in the testing of pin-type insulators, but the distribution of electric stress in a string of suspension units is generally similar under test conditions to what it will be in actual service. For the rain test or wet flash-over it is customary to use a precipitation of 0.2 in. per min., the spray being directed from one or more jets on the surface of the insulator at an angle of approximately 45 deg. to the vertical. The results obtained from the rain test will depend somewhat upon the exact manner in which the water strikes the insulator, and also upon the amount of salts or impurities in the water.

Routine tests are applied for the purpose of eliminating defective materials. Assembled pin-type insulators are placed in an inverted position in a shallow dish containing water, the metal pin or water in the hole for receiving the pin being connected to the high-tension wire from a step-up transformer. This transformer should be of large capacity. For testing 200 insulators at one time a transformer capacity of 200 kv-a. is desirable. Parts of insulators, before being assembled, receive a pressure test similar to that applied to the assembled insulator. Tubes or bushings are tested by having a metal rod passed through them and flexible wires, connected to the other terminal of the transformer, wrapped

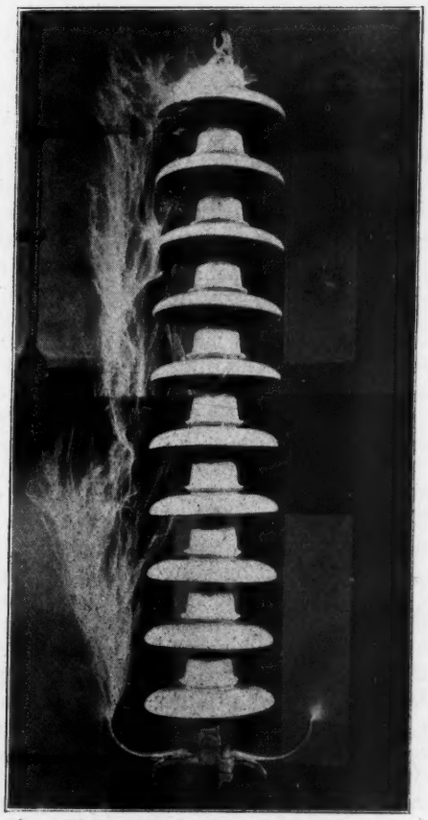


Arc-Over at 233,000 Volts on String of Five No. 5800 Units. Dry Rating Without Horns, 315,000 Volts.



Outline of "Victor" Suspension Unit No. 5800 Having Dry Arc-Over Rating of 90,000 Volts.

"Victor" Insulators Having a Dry Arc-Over Rating of 140,000 Volts With Tie Wire.



"O-B" Suspension Insulator Flashing Over at Approximately 500,000 Volts.

General Types of
INSULATORS
That Have Found Wide Application in and Stood the Hard Tests of Service

around the outside in the desired position. The pressure is raised sufficiently to cause intermittent flash-over, so that even under a normal supply frequency of 25 or 60 cycles the material between the two electrodes is actually subjected to high-frequency stresses. If necessary, the proper amount of reactance is put into the circuit to ensure an oscillatory discharge. These tests usually extend over a period of at least 5-min. duration.

Methods Employed in Testing Line Insulators in the Field.

On account of the deterioration of porcelain insulators in service it is advisable to test them periodically, preferably without interruption to service. When duplicate lines are available insulators may be disconnected from the supply and tested with the megger. By means of this instrument the resistance in megohms of the insulator may be measured directly. In conducting such a test one man on the pole or tower holds the two leads across the insulator while another man operates the small generator (usually delivering up to 1000 volts), and reads the instrument. Each company sets its own standard for minimum resistance, and if the test reveals a resistance lower than this standard the insulator or unit is replaced. The minimum value usually lies between 500 and 5000 megohms.

Several of the large companies operating at pressures above 60,000 volts make a practice of testing insulators in the field with the megger and thereby obtain results of considerable value, although this method of testing does not reveal all defects which may ultimately cause a breakdown of the insulator.

Although the "Buzz Stick" method of testing is used on both pin-type and suspension-type insulators it has not been attended with much success on the former type, but with suspension units it appears to be more successful. The "buzz stick" consists of a long insulating handle with two metallic projections at the end forming a continuous conductor by means of which a short-circuit may be put across an individual insulator in a string of suspension units.

Before making the short-circuit test it is customary to touch the metal cap of each insulator unit with one prong of the metallic fork. A small spark occurs because of the capacity of the fork which will be charged to the potential of the cap with which it is brought in contact. The caps are touched in succession, beginning with the one nearest to the line, which should produce the largest spark since the potential to ground decreases as the units tested occupy positions progressively nearer the point of attachment to the grounded crossarm. If there is a defective insulator in the string; that is to say, a unit which has broken down and has no appreciable potential difference between the two metal fittings, the spark from the cap of such a unit will be the same as the spark from the one preceding it. Experience is needed by the tester to determine which, if any, are the defective units. He judges mainly by the noise made by the spark as it jumps from the "buzz stick" fork to the cap of the insulator.

Should this test reveal a large number of defective units it might be undesirable to proceed with the short-circuit test, but if there appear to be enough sound units in the string to permit of these being short-circuited one at a time, the metal fork is then used to connect the metal fittings of each insulator unit. The spark obtained on this second test is that due to the discharge of the condenser formed by the cap and bolt separated by the porcelain dielectric. The test proceeds as before from bottom upward, and since the number of coulombs, or the amount of dielectric flux, will be greatest for the unit near the line, this should produce the largest spark, while units nearer the tower will produce smaller sparks depending upon the distribution of potential throughout the string of units. A defective insulator is at once detected because there will be no spark, or only a very small spark, when it is short-circuited by the "buzz stick".

Obviously, this method of testing is a rough-and-ready means of indicating whether or not the electrostatic capacity of a unit is about what it should be according to its position in the string. There might be certain flaws or surface conditions of the porcelain discs which would not be revealed by this method of testing, but which might nevertheless be the cause of a dangerous lowering of the flash-over voltage. The "buzz stick" is not likely to reveal incipient defects, but will merely show when the electrostatic capacity of the unit is appreciably less than it would be if the insulator were in perfect condition.

High-Resistance Telephone Receiver Used for Insulator Testing.

Another test for insulators while the line is in service makes use of a high-resistance telephone receiver. This test is used mainly on lines using pin-type insulators, as it is of less value with suspension-type insulators. One terminal of the telephone circuit is mounted on an exploring rod and may be brought near to, or actually in contact with, the transmission-line pole at a considerable height above ground. The other terminal is grounded. The telephone receiver is therefore in a circuit of which the general direction is parallel to the supporting pole. If there are leakage alternating currents of appreciable magnitude flowing in the pole a peculiar crackling noise is heard in the telephone receiver, but if all the insulators are in good condition nothing but a musical hum will be heard. This method will not detect a defective unit in a string of suspension insulators, and neither will it serve to discover partial breakdown in pin-type units made up of several porcelain parts; but several power companies are using it with a good measure of success.

By improvements in methods of testing insulators in service, and by systematic and extended use of such methods, the manufacturer of porcelain insulators will gradually accumulate a vast amount of valuable data which will enable him ultimately to correct weak points in design or manufacture, and so produce line insulators to satisfy all requirements. Porcelain has many disadvantages as a material for line insulators, but so much study and experimental research have lately been devoted to its improvement that there is little reason to doubt the ability of insulator manufacturers to keep pace with the rapid strides recently made in the machinery and other accessories used in connection with high-voltage electric power transmission on a large scale.

EDITORIAL COMMENT

Water Power in England

We are not accustomed to think of England as an ideal country for hydroelectric developments on a large scale, and for those unfamiliar with what is known as the "Severn Barrage Scheme" it will come as a surprise to learn that eminent engineers are seriously considering plans for obtaining more than half a million horsepower during a 10-hour day from the tidal waters of one river, the Severn. When it is further considered that a peak load of a million horsepower can be supplied by this (projected) hydroelectric plant it will be admitted that it does not compare unfavorably with the largest waterpower developments in this country. In round numbers the capacity of the Big Creek development of the Pacific Light & Power Co. is 350,000 hp., while that of the Amalagamated Niagara Falls Power Co. is 390,000 hp.

The scheme under consideration has been seriously proposed by the British Ministry of Transport. It has been much discussed and advertised by the daily newspapers, and—perhaps for this reason—ridiculed and severely criticised by many engineers and technical publications. It would appear, however, to have many features of peculiar interest, and if the cost of development is not excessive there is reason to believe that the scheme may actually be carried through.

The power available on the river Severn is far in excess of all other waterpower sources in the British Isles, but since this potential power is largely due to an estuary of very great capacity, combined with an exceptionally great difference of level between high and low tides, many unusual engineering features enter into this particular development. The biggest difficulty is, of course, the provision of adequate storage of energy which shall be available during periods of low tide. The proposal is to pump the sea water into high-level reservoirs during periods of high tide when the full capacity of the plant is available, and utilize this stored water for operating the turbines at low tide. The river Wye would be involved in this storage scheme which provides for the construction of a 40-ft. tunnel about a mile long through which the water would be forced up to the storage reservoir to be provided near Tintern Abbey.

The barrage will consist of a great concrete dam across the Severn within which the sluices and turbines will be installed for the utilization of the tidal water power. In addition to this installation there will be the energy-storage plant, with a pump and turbine house, which will be used to fill the above-mentioned storage reservoir and utilize the head thus provided.

The barrage is to be constructed on a site where the estuary is 2.5 mi. wide. A ship lock will be provided leading into an artificially constructed basin for shipping, which will have an area of about 27 sq. mi.

The power house in connection with the storage reservoir would be placed on the banks of the tidal portion of the river Wye, which runs into the Severn at this point. Electrically driven pumps to force the water into the reservoir would derive their energy from generators in the main power house during the times of high tide.

If this scheme materializes, the methods of overcoming the many difficulties of such an undertaking, and the results obtained from so unique a power plant, should be of considerable interest to engineers in all parts of the world.

A Nightmare of Frequencies

The fact that we have to contend with two frequencies, namely, 60 and 25 cycles, with occasional instances of departures from these recognized standards, is causing us a good deal of worry. But what must be the condition of mind of engineers with a respect for standardization in a country where "electricity supply undertakings" are able to offer the consumer the choice of 15 different frequencies? A study of the complete list of electricity supply undertakings in England, recently published by the *Electrician,* reveals the fact that this number of different frequencies is actually to be found. It is true that some of these may be classed among the freaks and exceptions, their presence being due in all probability to the desire of the lesser lights among the consulting engineers of Great Britain to stamp their individuality upon their work in the form of a frequency which will not operate in harmony with neighboring frequencies. The frequencies which may be so classified include 33, 70, 75, 77 and 93 cycles, with 67.5 to complete the list. We find three plants generating at 80 cycles and another three at 83 cycles. The great majority operate at 50 cycles, which European engineers who appreciate the advantages of standardization have endeavored of recent years to establish as a standard. In England legislation has not been favorable to the development of the electrical industry, and large centralized power sta-

tions with high-voltage transmission are now being seriously discussed for the first time. This explains why the number of isolated power plants is very great for a country of comparatively small area with thickly populated industrial centers. There are 223 electricity supply stations operating at a frequency of 50 cycles. The next most popular frequency for those desiring something different is 40, which has been adopted by 24 central stations. The very high frequency of 100, probably a relic of the early days of the industry, is furnished by 19 undertakings, while 34 electric light and power stations divide equally between them the frequencies of 25 and 60 cycles. This appears at first sight to be a very deplorable state of affairs, especially in view of the fact that the linking up of industrial areas to be served by economically located power stations of large size is now being considered. But many of the smaller stations will probably ultimately be shut down completely, so that the situation is not perhaps so serious as it appears at first sight. If there are dangers resulting from over-standardization—a possibility which we should not overlook—our friends in Europe, and especially in England, have yet a long way to travel before they run any risk of encountering them. It is true that an effort has been made in recent years by the British Board of Trade to standardize the frequencies of 25 and 50, but in certain portions of the North of England the "standard" is still 40 cycles.

Operating the Diesel Engine

The success or failure of a Diesel installation often depends on the engineer in charge. In some cases a steam plant has been changed to a Diesel plant and operated by the same engineer with success; in others the reverse is true. In most cases the repair bill for the first 6 months will be large due to unnecessary items caused by the inexperience of the engineer in charge. A steam engineer who is a good mechanic can learn to operate a Diesel in a short time if he is instructed by a competent Diesel engineer. When a particular type of engine is installed with a view to efficiency, a competent engineer is necessary to obtain the most complete efficiency possible.

One manufacturer states the average steam engineer can operate a Diesel after a few lessons from the erecting man, and that this is the usual manner of obtaining Diesel engineers for small plants in the Southwest. Another manufacturer states there is no such thing as an average steam engineer, and that the Diesel requires a man who is essentially an expert mechanic.

The Diesel is a high-grade and costly machine and should not be used for experimental purposes by a green man. It would be economical for many plants to send their engineer to the factory for instructions in Diesel operation and adjustment instead of having him learn from their installation, with a resultant depreciation of the engine.

Fixed Charges in Hydoelectric Development

The influence of fixed charges upon the commercial success of hydroelectric developments is so great that probably in no branch of engineering does foresight count more heavily. Work of this kind is of immense importance and warrants the cost of expert services in the great majority of cases. On rivers susceptible of multiple developments within short distances snap judgments are perilous, and nothing short of exhaustive investigation by competent engineers should be used as the basis of plant and hydraulic construction. In one instance recently heard of the company studied the hydraulic conditions for 3 years before finally deciding to enlarge its existing canal and headworks rather than build a second dam in the neighborhood of the plant, but when the final conclusion was reached everyone associated with it was convinced that the best solution had been attained.

Radio Development

Developments of the highest importance to the world took place during the war in the realm of radio communication. Both radio-telegraphy and radio-telephony have been made more reliable, more extended in their application and much more serviceable in many respects. This is of incalculable benefit to the world in keeping both near and distant countries in more intimate contact with each other. It has been truly said that the better we understand one another the more amicable are our relations with each other. By greatly improving the means of communication, the recent radio improvements have therefore aided in making universal peace more probable.

Sell Municipal Light Plant

After operating its own municipal lighting plant for 26 yrs., the town of Wakefield, Mass., at a special town meeting, voted 300 to 221 to sell the plant to the highest bidder. In the opinion of the people of the town, municipal ownership proved a failure in that the Wakefield town plant sold gas to its patrons for $2.20 a 1000 cu. ft., while neighboring towns got their gas for 70 cts. less. Within the past month the price of gas increased 40 cts. in Wakefield and another raise was thought possible. The plant is valued at $500,000.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

I. E. L. A. COMMERCIAL SECTION TO MEET NEXT WEEK.

Customer Ownership of Public Utilities and Electric Industrial Hoists Among Subjects to Be Discussed at Muncie Meeting, March 10.

The Commercial Section of the Indiana Electric Light Association will meet in Muncie, Ind., March 10, at 10 a. m. The following program has been arranged for the occasion:

Address of welcome by Charles O. Grafton, president of the Muncie Chamber of Commerce, and response by Morse Dell Plain, president of the Indiana Electric Light Association; address on "Customer Ownership of Public Utilities," by R. H. Moran, manager of the stock and bond department, Interstate Public Service Co. In the afternoon the following addresses will be given: "Central Station Steam and Hot Water Heating," by H. C. Kimbrough, secretary of the American District Steam Co., North Tonawanda, N. Y., and "Electric Industrial Hoists," by W. D. Campbell, manager of the Indianapolis office of the Sprague Electric Works of General Electric Co.

At 8 p. m. a banquet will be held on the third floor of the Anthony block, following which addresses will be made on "The New Era in Illumination" and "High Intensity Illumination Exhibit," by R. W. Shenton, assistant manager of the engineering department, Nela Park, Cleveland, and O. F. Haas, illuminating engineer, Nela Park, Cleveland, respectively.

GOODWIN JOINS S. E. D. STAFF AS ASSISTANT TO PRESIDENT.

Activities of Society to Be Broadened Under Direction of General Manager Wakeman, W. L. Goodwin and Executive Committee.

Announcement has been made by W. W. Freeman, president of the Society for Electrical Development, that William L. Goodwin has joined the Society's staff in the capacity of assistant to the president. By securing the services of Mr. Goodwin the Society aims to consolidate the efforts which have been exerted so actively in recent years in the interests of genuine electrical co-operation throughout the country, with the systematic work conducted by the Society for Electrical Development, and by such direct consolidation, to promote co-operative development throughout the industry along lines of the broadest scope and most intense activity. J. M. Wakeman as general manager and Mr. Goodwin as assistant to the president will direct the activities of the Society co-ordinately under the authority of the president and with the active advice and support of the Executive Committee and the Board of Directors.

The directors' meeting held last month, at which broad plans of expansion were discussed and unanimously approved, was attended by 15 directors. The program of work for the Society during the coming year is being planned with enthusiasm, and the announcement of further important developments may be expected from time to time.

In connection with the above announcement the General Electric Co. has isued the following information from the Schenectady (N. Y.) office: "William L. Goodwin, who for the past 3 yrs. has been associated with the General Electric Co. in carrying on electrical trade development work in various sections of the United States and Canada, was on March 1 appointed assistant to the president of the Society for Electrical Development to initiate similar work on a broader scale among the activities of the society.

"Tremendous opportunities for development and for service to mankind now await the electrical industry, and the Society for Electrical Development is the logical agency for taking the leadership in the vast development which must come in the next decade. Mr. Goodwin has displayed such remarkable powers of vision in foreseeing the opportunities for the electrical industry that the General Electric Co.," explained A. W. Burchard, vice-president of the company, "felt obligated to accede to the wishes of the Board of Directors of the Society and has accordingly assented to the arrangement, pursuant to which Mr. Goodwin will initiate under the Society's auspices the activities he has in mind.

"This arrangement will make available for the Society, and for the electrical industry at large in a way not previously possible, Mr. Goodwin's wealth of ideas and fund of knowledge of electrical trade matters and great talent for organizing and for inspiring men to action. Mr. Goodwin during his stay with the Society will continue to have the support and confidence of the General Electric organization."

CO-OPERATION, THEME OF DEALERS' MEETING.

Electrical Contractors and Dealers of Tri-Cities Meet in Davenport to Discuss Plans for Developing Local Industry.

B. J. Denman, president of the Tri-City Railway & Light Co., Davenport, Ia., addressed 60 Tri-City electrical contractors and dealers at the Davenport Chamber of Commerce recently on the topic of "Co-operation Between the Central Station and the Contractor-Dealers." Mr. Denman's address was the result of an organized movement of electrical contractors and dealers of Davenport, Rock Island and Moline, Ill., to develop the local industry by means of get-together meetings. In January a committee of five was appointed by the contractors and dealers to study and devise

creative plans on which the organization should progress. The committee decided that the first move would be to seek counsel from the president of the largest electrical concern in the Tri-Cities, namely, the Tri-City Railway & Light Co.

Mr. Denman emphasized the fact that electricity in the home was no longer a luxury, but a necessity, and that its importance to industry had not yet been fully developed. He also called attention to the fact that rates for electric service had not increased during the war to any perceptible degree and that the average bill per consumer was only $20 a year. He further stated that adequate rates were essential to the maintenance of proper service and that the consumer should pay somewhat higher rates so as to receive the best of service.

PROMINENT SPEAKERS TO ADDRESS OKLAHOMA CONVENTION.

Governor J. B. A. Robertson will deliver the address of welcome at the third annual convention of the Oklahoma Utilities Association to be held at the Huckins Hotel, Oklahoma City, Okla., March 8-10. Other state speakers, not previously mentioned, will include John W. Shartel, vice-president and general manager of the Oklahoma Railway Co.; Paul Walker, referee of the state supreme court, and H. W. Hubenthal, telephone engineer of the corporation commission. About 15 speakers of note from outside the state will address the convention. Hundreds of utility operators from all parts of the state will not only attend, but many utility men and dealers in electrical and telephone equipment from various parts of the Union will also participate in the convention. A banquet will be given on the evening of March 9.

THE ENGINEER'S PART IN SUCCESS OF UTILITIES.

Recent Editorial on "The Engineer and Utility Valuation" Brings Interesting Communication From California Consulting Engineer.

In the Feb. 19 issue of ELECTRICAL REVIEW there appeared on page 313 an editorial entitled "The Engineer and Utility Valuation," which has brought forth the following comments from C. Wellington Koiner, consulting engineer, Pasadena, Cal.:

"Why use the engineer at all to set up a valuation. If all he has to do is what you state in your editorial he is just a kind of second-rate individual in the service of a large corporation, whose opinion on economics is to be entirely ignored. By the way, who are the men who successfully direct our utilities? Is it not the broad-minded, experienced engineer? Just go over the list of the big companies and ascertain for yourself if, at the bottom of the success of these utilities, it is not the guiding hand of the engineer, the one who displays a liberal amount of that rare quality, horse sense or common sense.

"In these matters of valuation, if the company wants to be honest the engineer can arrive at the real value without difficulty. It is only when the company wants to value the property in excess of what the company has invested in it that we get into trouble. You know quite well that the chief difficulty in valuation work is that the company wants to set up a higher valuation than they have spent real money for.

"I protest against the depreciating value you put upon the engineer in this class of work and say frankly that if you could eliminate a few of the lawyers in this class of work and let the engineers settle it, I am sure the public as well as the companies would be much better satisfied with the results—that is, the honest results thus obtained.

"We do a great deal of talking about Americanism and square dealing, but you must confess that eternal vigilance is the price we must all pay to prevent the other fellow's putting something over on us. If this country is to endure, and we have all been much concerned the last year or two, we must endeavor to settle our economic problems on a sound and just basis. If we eliminate the Golden Rule we cannot hope to have any improvement."

We were interested in Mr. Koiner's communication and shall be pleased to receive any further comments on the subject, pro or con.

DISCUSS ELECTRICITY IN AERIAL TRANSPORTATON.

Many Useful Devices and Applications Already Developed, But Practical Use Must Be Made on Large Scale to Accomplish Real Results.

Charles F. Kettering, president Dayton Engineering Laboratories Co., Dayton, O., gave an interesting and instructive talk on "Dependence of Aerial Transportation on Electricity" before the Feb. 28 joint meeting of the American Institute of Electrical Engineers (Chicago section) and the Western Society of Engineers. After pointing out the many advantages of aerial transportation due to its inherent speed and safety, Mr. Kettering told of the need of proper landing fields provided with materials and equipment required to utilize the new means of transportation. The establishment of definite routes, with radio guide or marking stations, will make flying possible in all kinds of weather with assurance that the aviator will at all times know just where he is and just what course he is following.

Electrical equipment on the landing fields will make it possible to definitely locate the exact position of the field regardless of weather conditions or light. Still other electrical equipment makes it possible to determine the exact distance between the machine and ground when approaching a landing. These devices make it possible for the aviator to come to a perfect landing without even seeing the ground. These and many other interesting things were outlined, but, according to Mr. Kettering, the most important factor in aviation development is the establishment of fields and routes. In a short talk preliminary to the introduction of Mr. Kettering, B. J. Arnold told of the organization and activity of the Chicago Air Board. This organization is actively engaged in the development of aviation facilities in and near Chicago, and expects ultimately to help carry through all the many things required to make the city a center of aerial transportation.

NEW YORK SECTION OF A. I. E. E. AMENDS CONSTITUTION.

Amendments to the section by-laws authorizing the nomination of officers in March and their election in April were unanimously adopted at the meeting of the New York Section of the American Institute of Electrical Engineers held Feb. 25 at the Engineering Societies building, New York City, and hereafter succeeding officers will have an opportunity to discuss policies with presiding

officers and become acquainted with their official duties before taking office Aug. 1.

Dr. Saul Dushman, research engineer of the General Electric Co., gave an illustrated lecture on the "Theory and Application of Hot Cathode Devices," and with experiments made clear some of the more obscure phenomena in this fascinating subject. Also information relating to new developments in the engineering and in the fundamental physics of this field was presented and the electron theory discussed in non-technical language.

CONSTRUCTION WORK FINANCED FROM EARNINGS.

The report of the North American Co., New York City, and its subsidiaries, covering the calendar year 1920, was issued this week by Harrison Williams, chairman of the executive committee. Gross earnings amounted to $39,611,162, an increase of 30.54% over 1919. Balance for depreciation, common dividends and surplus was $5,396,288, an increase of 17.81%, equivalent to $18.11 a share on North American stock, before reserves, as compared with $15.38 in 1919.

A feature of the balance sheet is the investment of $119,504,435 in property and plant, or about $3 per dollar of gross earnings. Property and plant investment increased $12,376,041, while capital liabilities increased only $9,895,540, indicating that about $2,500,000 of construction expenditures were financed out of earnings and reserves. In addition to substantially increasing the reserves for depreciation, the subsidiaries expended $4,941,331 for maintenance and renewals. Net working capital amounted to $6,916,896, an increase of nearly a million dollars during the year. Accumulated reserves and surplus total $27,708,533, an amount in excess of 90% of the entire outstanding stock of the North American Co.

A significant feature of the 1920 report is the small proportion, about 13%, of net income of subsidiaries derived from street railways, while more than 71% was derived from electric and heating and the balance from gas and coal operations. This showing and the fact that the company's entire investment in the United Railways Co. of St. Louis is carried on its books at $1, dispel any impression which may have prevailed that railway operation is the principal source of subsidiary net earnings.

ELECTRIC CLUB HEARS TALK ON ILLUMINATION.

W. D. Ryan, engineer, illuminating engineering laboratories of General Electric Co., gave a most interesting and instructive talk on "Illumination —Ancient and Modern," before the March 1 meeting of the Electric Club of Chicago. Mr. Ryan presented a number of colored slides showing the history of illumination from its earliest stages to the present time. He then described and showed illustrations of the lighting and lighting effects at the Panama-Pacific Exposition, and closed his talk by describing some of the recently developed applications of street lighting.

In describing various recent applications, attention was called to the fact that these installations were proving to be of great commercial value in addition to improving the appearance of the districts where used.

PROJECTILE PROBLEMS DISCUSSED AT A. I. E. E. MEETING.

Major Gordon F. Hull, of Dartmouth College, lectured recently before the Lynn (Mass.) Section of the American Institute of Electrical Engineers on "Some Physical and Engineering Problems Connected With Guns and Projectiles." During the war Major Hull was in charge of many interesting experiments to determine the characteristics of "projectile flight," and his lecture dealt with air streams of high velocity, factors determining forces on projectiles and other bodies, factors controlling the bursting of guns, and the measurement of the expansion of a gun during firing. The annual banquet of the Lynn Section will be held at the City Club, Boston, March 19.

WILL DEMONSTRATE PRINCIPLES OF GOOD LIGHTING.

Two joint meetings of the Chicago sections of the Illuminating Engineering Society and the Society of Industrial Engineers on the general subject of "Lighting," will be held in the lighting demonstration room of the Central Electric Co., 316 South Wells street, Chicago, March 8-9. In order to accommodate all members of both societies the lecture and demonstration will be given on the two evenings of Tuesday and Wednesday of next week, at 7:30 p. m. The lecture and demonstration are purely educational in character and are arranged for the purpose of spreading a wider knowledge of the principles of good lighting.

HYDROELECTRIC PERMITS GRANTED BY COMMISSION.

The Niagara Falls (N. Y.) Power Co. was granted a 50-yr. license Feb. 28 by the Federal Power Commission to use 19,500 cu. ft. a sec. of 20,000 cu. ft. of water, permitted by a treaty with Canada to be diverted from the Niagara river above Niagara Falls. The commission also approved an application of Henry Ford for a power development project at Troy, N. Y., on the Hudson river, to cost $2,500,000 as the power source for a factory project involving an expenditure of $7,500,000.

MEETINGS OF THE A. E. S. C.

The American Engineering Standards Committee, of which P. G. Agnew, 29 West 39th street, New York City, is secretary, has announced that its Main Committee will hold meetings March 5 and June 4.

DISCUSS CHANGES IN ELECTRICAL CODE.

The Electrical Conference assembled in Philadelphia last month, with Chairman Devereux presiding. The first portion of the meeting was taken up by the presentation of the "Grounding of Secondaries and Practices in Philadelphia," which subject was presented by Richard H. Sil-

bert, Philadelphia Electric Co. William Baldwin, Philadelphia Fire Underwriters' Association, enumerated the changes in the 1920 edition of the National Electrical Code and brought out very clearly just what the different requirements were of the new Code as compared with the old one.

BROOKLYN EDISON STOCKHOLDERS ELECT DIRECTORS.

At the annual meeting of the stockholders of the Brooklyn Edison Co., the following were elected directors for the ensuing year: Frank Bailey, Charles A. Boody, James C. Brady, N. F. Brady, H. L. Bridgman, William C. Courtney, Daniel J. Creem, H. C. DuVal, Walton Ferguson, George B. Gallagher, Adrian T. Kiernan, Thomas E. Murray, Franklin W. Slater, M. S. Sloan and W. F. Wells. The entire board was re-elected except Franklin W. Slater, who takes the place of William V. Hester, resigned.

NEW CENTRAL STATION PROPOSED FOR NORTHERN ILLINOIS.

It is reported on good authority, but not as yet officially confirmed, that a new generating station of large capacity, probably 200,000 kw., will be erected by the Public Service Co. of Northern Illinois just north of Waukegan (Ill.) along the shore of Lake Michigan. A tract of land was secured at this location some time ago to be used ultimately as a station site. If plans are completed and pushed through at the present time it is possible that the station might be put in service some time next year.

WISCONSIN LINE WORK PLANNED.

The Interstate Power Co., operating in Southern Wisconsin, expects to change over about 20 mi. of 13,200-volt transmission line during the year, reconstructing the line to operate at 33,000 volts. In addition to this an extension from Lancaster, Wis., to Bloomington, Patch Grove and Mt. Hope, all Wisconsin towns, is being put through. This new line is being constructed for 33,000-volt operation and will provide the initial service in these three towns.

A. I. E. E. TO MEET NEXT WEEK.

"Developments in Conversion Apparatus for Edison Systems" is the subject to be discussed at the 368th meeting of the American Institute of Electrical Engineers, to be held in the Engineering Societies building, New York City, March 11. The program will be under the auspices of the Power Stations Committee, and the subject mentioned will be introduced by T. F. Barton and T. T. Hambleton, both of the General Electric Co.

ELECTRICAL JOBBERS' MEETINGS.

The Electrical Supply Jobbers' Association, of which Franklin Overbagh, 411 South Clinton street, Chicago, is general secretary, will hold the following meetings during this month: Atlantic Division, New York City, March 15; Central Division, Chicago, March 15; Executive Committee, Cleveland, March 16-17. The 13th annual meeting of the entire Association will be held at Hot Springs, Va., May 25-27.

COMING CONVENTIONS.

Oklahoma Utilities Association. Annual convention, Oklahoma City, Okla., March 8-10. Headquarters, Huckins Hotel. Assistant manager, O. D. Hall, 1107 First National Bank building, Oklahoma City.

Indiana Electric Light Association. Meeting of Commercial Section, Muncie, Ind., March 10. Headquarters, Hotel Roberts. Chairman, R. Thurman, Muncie.

Associated Manufacturers of Electrical Supplies. Annual convention, New York City, March 15. Headquarters, 30 East 42d street, New York City. General secretary, Charles E. Dustin, Hartford, Conn.

Electrical Supply Jobbers' Association. Quarterly meeting of Atlantic Division, New York City, March 15. Headquarters, Hotel Commodore. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Joint meeting of Illinois State Electric Association, Illinois Electric Railways Association and Illinois Gas Association, Chicago, March 15-17. Headquarters, Sherman House. Secretary, R. V. Prather, Springfield, Ill.

American Washing Machine Manufacturers' Association. Meeting at Sherman Hotel, Chicago, March 16-17. Secretary, Enoch B. Seitz, Otis building, Chicago.

Wisconsin Electrical Association. Annual convention, Milwaukee, March 22-24, jointly with the Wisconsin Gas Association. Secretary, J. P. Pulliam, 1408 First Wisconsin National Bank building, Milwaukee.

Kansas City Electrical Show. First annual electrical exposition, Convention Hall, Kansas City, Mo., April 18-23. Manager, Sam Furst, Electrical Trades Exposition Co., 802 Broadway, Kansas City, Mo.

American Electrochemical Society. Spring meeting, Atlantic City, N. J., April 21-23. Headquarters, Hotel Chalfonte. Secretary, Joseph W. Richards, Lehigh University, Bethlehem, Pa.

American Society of Mechanical Engineers. Spring meeting, Chicago, May 23-26. Headquarters, Congress Hotel. Assistant secretary, C. E. Davies, 29 West 39th street, New York City.

International Railway Fuel Association. Annual convention, Chicago, May 24-26. Headquarters, Hotel Sherman. Secretary, J. G. Crawford, 702 East 51st street, Chicago.

Electrical Supply Jobbers' Association. Thirteenth annual meeting, Hot Springs, Va., May 25-27. Headquarters, The Homestead. General secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Pacific Coast Geographic Division of the National Electric Light Association. Annual convention, Del Monte, Cal., May 25-27. Headquarters, Hotel Del Monte. Secretary, L. H. Newbert, 445 Sutter street, San Francisco.

National Electrical Light Association. Annual convention, Chicago, May 31-June 3. Headquarters, Drake Hotel. Executive manager, M. H. Aylesworth, 29 West 39th street, New York City.

North Central Electric Association. Annual convention, Duluth, Minn., June 14-16. Secretary, H. E. Young, 15 South Fifth street, Minneapolis, Minn.

Tri-State Water and Light Association. Annual convention, Asheville, N. C., June 15-16. Secretary, W. F. Steiglitz, Columbia, S. C.

National Fire Protection Association. Annual convention, San Francisco, June 14-16. Secretary, Franklin H. Wentworth, 87 Milk street, Boston.

American Institute of Electrical Engineers. Annual convention jointly with the Pacific Coast convention, Salt Lake City, Utah, June 20-25. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

North Central Geographic Division of the National Electric Light Association. Next convention, Duluth, Minn., June 21-23. Headquarters, Spaulding Hotel. Secretary, H. E. Young, 15 South Fifth street, Minneapolis, Minn.

National Association of Electrical Contractors and Dealers, Anniversary convention, Buffalo, N. Y., July 20. Secretary, W. H. Morton, 110 West 40th street, New York City.

CONTRACTING-CONSTRUCTING

A Department Devoted to Various Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

USE OF ARMORED CABLE TO WIRE OLD RESIDENCES.

Lights and Switches Located Wherever Desired Without Damaging Decorations or Causing Great Inconvenience to Tenants.

Once it was thought quite impossible to wire an old building for electric light, and people owning fine old homes did not want them torn up and disfigured in an effort to install electric wires. For this reason they used oil and gas for many years, although they realized that electricity was better and safer. Unfortunately, by far the greater number of homes in this country were erected before the advent of electric light. It is quite an easy matter to install wiring in a new building in course of construction. In this case the conduit is all installed before the plastering, floors and molding are put in place, but when an attempt was made to put in a network of concealed wiring in an old house the result was anything but pleasing.

Now all this is changed, and it is possible to wire the largest homes without breaking the plaster, and still have the wiring completely concealed. It can readily be imagined that when circuits can be laid across the floor in one direction by raising a single board, and can be run in the other direction at right angles to this simply by removing and afterwards replacing a part of the baseboard, the flooring need be disturbed very little. As for the outlets for brackets and switches, baseboard outlets, etc., they are connected by "fishing" the wires up or down between the joist and lathing which forms the wall on either side, the wires being brought out readily at any point previously selected after a test of the space shows it to be free of obstructions. In this way some of the finest residences containing beautiful hand-painted ceilings and tapestried walls have been completely wired without the necessity of any expenditures for redecoration on account of the wiring work.

Suppose that we take the average 2-story house with attic and basement, or, in place of the attic, the usual space between the ceiling of the upper floor and a flat roof which is generally of ample size for the required work. If the service mains are on poles in the alley at the rear they must be brought over to a point on the outside of the building from which a straight drop can be made in iron pipe to the basement, where the service meter, cutout box and main switch may be located. The next step is to explore the walls preparatory to running the circuit wires in flexible conduit to the points where light or switch outlets are wanted. This is done very easily, and is called "fish work."

In "fishing" work a piece of flexible steel tape is used to explore the space between joists, and perhaps a baseboard section is removed upstairs and a brass chain such as that used by plumbers is dropped down to meet this from above. When it is found that it is quite easy to pull the chain through, it is a safe conclusion that the circuit wire in its flexible conduit will be able to follow through in the same place, and the matter is generally worked out in that way. Having located the center of distribution, the number of lamps that will be required in each room should be noted, and the number of circuits which will be required to carry them may then be readily determined by the standard rules permitting a load of 660 watts per circuit. A rough working plan can then be formed with the object of reaching all the outlets with the least waste of material and labor; that is, in the most direct manner. For instance, a single circuit may be all that is needed for each floor in a moderate-sized residence, a branch being taken off for each room and subdivided if necessary for the different outlets in that room.

Wall Switches Located Where Desired to Control Circuits.

Wherever a wall switch is wanted to control a lighting connection one side of the circuit is led down to the switch and looped back again, in all this work the same method of exploration and fishwork being carried out. An experienced wireman is able to get around almost any difficulty without having to cut plaster in order to reach the desired outlet. It may take a little more wire than would be used in installing the circuit while the house was in process of being built, but between the possibilities of running a circuit behind the baseboard around the room, or across the floor by raising a single board in the floor, or by putting a particular outlet on another circuit branch coming from a different direction entirely, and by leading circuits down in molding inside clothes closets and similar unimportant places, it is possible to put every switch and every light at practically the exact spot that may be indicated before the work is started without making a single hole in the plaster except at the various points where a fixture or switch is to be attached.

DOUBLE INSPECTION OF ELECTRICAL CONSTRUCTION WORK.

Code Amendment in New York City Would Require Municipal Inspection in Addition to Work of Board of Fire Underwriters.

Contemplated changes in the municipal code of New York City provide for an inspection of electrical construction work by city inspectors. The changes provide for a schedule of fees and charges to be collected from the owners of the property on which the work is installed. Much opposition to the changes has developed and it is contended that electrical inspections by the city,

as contemplated, are unnecessary and obstructive, in view of the fact that such inspection as is necessary to insure the public safety is already adequately performed under the direction of the Board of Fire Underwriters without expense to property owners. The thoroughness and promptitude of insurance inspections is assured by the fact that such thoroughness is necessary to protect the financial interest of the companies concerned. In practice, it is contended, insurance inspection has proven entirely satisfactory and efficient, and it is therefore unnecessary for the city to provide for a second inspection which involves material expense to property owners and is the cause in many instances of material delay in obtaining light and power.

In protesting against the proposed new schedude of license fees it is said that the inspections for which these fees are to be charged are needless, obstructive, and impose a large and wasteful charge upon the owners of properties.

ELECTRICAL EQUIPMENT IN AN ICE CREAM PLANT.

Motors Used for Many Purposes in Manufacture of Ice Cream—Dead-Front Switching Equipment Employed for Safety and Convenience.

The plant of the Eilert Products Co., at Fresno, Cal., presents an example of the re-adaptation of a brewery plant to ice-making, ice-cream production, and other work. Especial reference may be made to the electrical installations in the ice-cream department where new equipment is being added that will increase the plant capacity to 8000 gals. per day. As thus increased, the factory requires a considerable motor capacity. Central-station energy is brought into the plant at 11,000 volts over a 3-conductor cable of No. 4 wire, and this voltage is stepped down to 220 by three Westinghouse 20-kw. transformers. A secondary switchboard for distribution is made up of Square-D units serving motors in all departments. A 2.5-in. conduit carries a set of No. 000 rubber-covered cables to 30-ampere Square-D switches in the ice-cream department, where motors are used to drive mixers, pasteurizers, homogenizers, ice-crushers, freezers, can washers, pumps and elevators. For most of these operations high-speed motors of 2 to 5-hp. capacity are required, all being equipped with General Electric controllers. The speeds of the various machines are determined by gearing by which the machines and motors are connected.

The recent installation of electrical equipment in this plant was made by the Valley Electrical Supply Co., of Fresno.

CALIFORNIA NEEDS $1,000,000,000 FOR ELECTRICAL CONSTRUCTION.

Hydroelectric Development on Large Scale Required to Supply Power for Domestic, Agricultural and Industrial Purposes.

In a report recently sent out to 1500 banks and financial houses in California, James R. Nourse, director of research for the Bureau of Economics, Sacramento, Cal., pointed out the needs of hydroelectric development in the state on a vast scale. His report reads in part as follows:

"The shortage in hydroelectric power in California during the past year amounted to 20% of total demands. In other words, in 1920 our various industrial and agricultural enterprises needed 100,000 hp. more than they were able to obtain.

"In order to make apparent what this shortage really meant to the business of the state, it is necessary to translate this shortage of electricity into terms of everyday business.

"In order to do so properly, it must be remembered that in the construction of a modern distributing system the output of that system is balanced as carefully as possible among the various demands made upon it.

"Therefore, the 100,000 hp. of hydroelectric energy which California was short last year meant that we lacked power and light to serve 64,500 residences, 1,000 factories, and the power to irrigate 300,000 acres of land.

"In addition to the service which this power would have rendered, had it been available, we would point out that in order to add this amount of power to our available electric energy there would have been expended for each 50,000 hp. developed approximately $45,000,000 for the building of power plants, distribution systems, stations and other equipment. This expenditure, however, would have returned to us four-fold in the reclamation of lands lying idle and by the turning of wheels in factories now waiting to be built.

"Expenditures in California, following such development, would, it is estimated, approximate $185,000,000 for new residences, $75,000,000 for factories capable of employing a total of 25,000 men, and $15,000,000 for the development of lands, while the annual yield from the manufactured products alone would have added a value of more than $100,000,000 to the state.

"We do not need to point out that the shortage of hydroelectric power within California will increase year by year unless there is a steady and corresponding growth in the amount of hydroelectric energy coming in. California has a potential maximum of 4,000,000 hp. of hydroelectric energy commercially practicable to be developed. This figure represents the amount of primary sources alone, and probably as much more can be developed from secondary sources, but at a much higher cost.

"Yet in spite of this very large potential capacity there has been developed to date not more than 1,000,000 hp. This figure alone shows the extent to which development must now go forward to keep pace with and stimulate growth.

"The Railroad Commission has reported to the Governor of California, and the governor has called the attention of the state legislature to the fact that more than $2,000,000,000 must ultimately be expended in California alone for the development of water power. It is estimated that to keep up with the demands for power, to protect California industries against a recurrence of power shortage, and to guard against the rapid consumption of reserve oil stocks and the increasing drain on the natural-gas supply, there must be developed before 1930, if possible, and certainly before 1935, approximately 3,000,000 hp.—this at a cost of about $1,000,000,000."

STUDIES IN DIRECT EVALUATION OF WATER POWER.

The direct evaluation of the water power of a basin generally necessitates a long and delicate study, based on the observations of several years.

A sufficient number of such studies and observations is now available to permit their particular results to be co-ordinated, and general indications evolved from them, which will permit of the determination, more or less approximately, of the hydraulic characteristics of a stream, as a function of the climatic and hydrological characteristics of its basin. A. Coutagne has explained in detail how such studies may be made in the Aug. 21, 1920, issue of *Revue generale de l'Electricite.*

QUESTIONS and ANSWERS

All Readers Are Invited to Submit Contributions on Electrical Matters to This Department—Answers Should Be Sent Within Eight Days of Date of Publication of Question—Payment Will Be Made for All Answers Published

Questions.

No. 510.—Advisability of Holding Sales of Electrical Goods.—I have been endeavoring to learn from various sources, including jobbers, dealers, etc., the advantages to be gained by and the difficulties met with in conducting a sale or sales of electrical goods. Other merchants have sales for the purpose of raising money, reducing stock and cultivating new customers, and I want to find out if the electrical dealer can benefit by following their example. Will dealers or others in touch with the situation give their views on the subject?—W. R. B., Phoenix, Ariz.

No. 515.—Precautions Taken in Grounding Lines and Buses.—What precautions are taken to guard against errors in making ground connections in power houses to high-tension cables and buses? Mistakes that have been costly in both life and property have been made, and it is believed that a free discussion of present common practice will be of much benefit. What bus- and line-clip arrangements are used? What locks and hold cards are used? Is it common practice to check connections twice or to have two different men check the connections? Are definite steps taken to see that the ground is maintained even though a mistake has been made?—A. L. T., New York City.

No. 519.—Protecting Transformer Poles Near School Buildings.—In the safety-first meetings of the company where I am employed the matter of protecting transformer banks near school buildings has been brought up. The proposition is to determine what protection is required to prevent accidents that might result from children climbing the poles. What precautions are taken by other companies to guard against such accidents?—C. W. B., Enid, Okla.

No. 520.—Design of Windings for Induction Motors.—Will someone give formulas and examples for determining the proper size of wire and number of turns to be used in winding one, two and three-phase induction motors to operate on 25, 50 and 60-cycle lines at from 110 to 500 volts?—S. M. C., Quebec, Canada.

No. 521.—Drilling Glass, Marble and Porcelain.—Will some one please supply information as to the proper methods to be used in drilling glass, marble for switchboards, and porcelain?—O. M. B., Jackson, Mich.

Answers.

No. 514.—Illumination of a Machine Shop.—What is the best method to employ and what intensity in foot-candles should be used in lighting a fairly large machine shop? The shop in question is 50 by 200 ft. in size and has a saw-tooth roof with windows all along both sides and the ends. Drill presses, planers, shapers, saws, milling machines and other tools all have individual motors so that there are no belts to interfere with overhead installation. Should a system of general illuminating be installed, or would a mixed system of general and local lighting be better or cheaper? What special provision should be made for the work benches along the sides of the shop? If general illumination is best, what intensity should be used and what size lamps would give the best results?—N. S. T., Detroit.

Answer.—The foot-candle intensity required by the state of California is briefly as follows: Rough bench and machine work, 2 to 6; medium bench and machine work, 3 to 9; fine bench and machine work, 4 to 12, and extra-fine work, 7 to 15 foot-candles. In general the more lamps used the more even the illumination. Therefore the more lamps used the smaller the individual units, but the installation cost will be more. However, it is better to err on the side of more lamps as there will be less trouble from shadows and uneven illumination.

Assuming an intensity of 12 foot-candles, and allowing 1.7 watts per sq. ft. to produce this illumination, we would require 17,000 watts to illuminate the room. As the mounting height of the lamps is not given, I am assuming that the lamps will be mounted 10 ft. from the floor and that metal reflectors and diffusing caps will be used. For a mounting height of 10 ft. a spacing of 12 ft. will give satisfactory results. This will give four rows of lamps lengthwise of the shop, the outside rows being 7 ft. from the walls. Lengthwise of the shop we would have to space the lamps 11.75 ft. apart and 6 ft. from the outside walls to get an even spacing. This gives us 64 lamps to illuminate the shop.

As it requires 17,000 watts to produce the required illumination, and this wattage is to be divided between 64 lamps, the proper rating for each lamp would be 265 watts. As there is no lamp of 265-watt rating we will have to use a 250-watt lamp, which will probably be sufficient.

For the work benches along the sides of the room the row of lamps 7 ft. from the walls will probably be sufficient for all except very fine die work.—C. O. R., Ontario, Cal.

No. 516.—Winding for Three-Phase Motor.—I have a four-pole, 220-volt, three-phase induction motor rated at 0.5 hp. and rewound with 24 coils in 24 slots. The coils are arranged and connected as a lap winding. The motor, which was made by the General Electric Co., Schenectady, N. Y., has a squirrel-cage rotor. The coils are connected in one Y circuit, there being two coils per group with 109 turns of No. 20 double-cotton-covered wire per group. The winding pitch is from 1 to 6.

Will someone draw a diagram illustrating the direction of curren flow in the windings described above? Considerable trouble is being experienced with heating. It is believed that some of the coils are bucking each other. The full-pitch winding of this motor would be from 1 to 7.—R. J. B., Racine, Wis.

Answer.—The diagram, Fig. 1, gives the connections as they ought to be at present, the lap (parallel) winding comprising four parallel groups of coils for each phase according to the four poles. If the current in the three phases of the motor winding is chosen at some particular instant, as for example at the instant shown in Fig. 2, where the current in phase *1* is at the maximum and the current in phases *2* and *3* is at half the maximum value and in opposition to that in phase *1*. The little arrows in the slots in Fig. 1 indicate the proper direction of the current in each coil in the slots. Two coils lie in each slot, and in the diagram the left-hand coil is the upper one, the right-hand coil being at the bottom of the slot. For the sake of simplicity only one turn of each coil is given. The plus signs under center slots indicate that the current in the two coils of those slots is in the same direction; the minus sign indicates opposing current in the two coils. It will be seen that in four slots which are

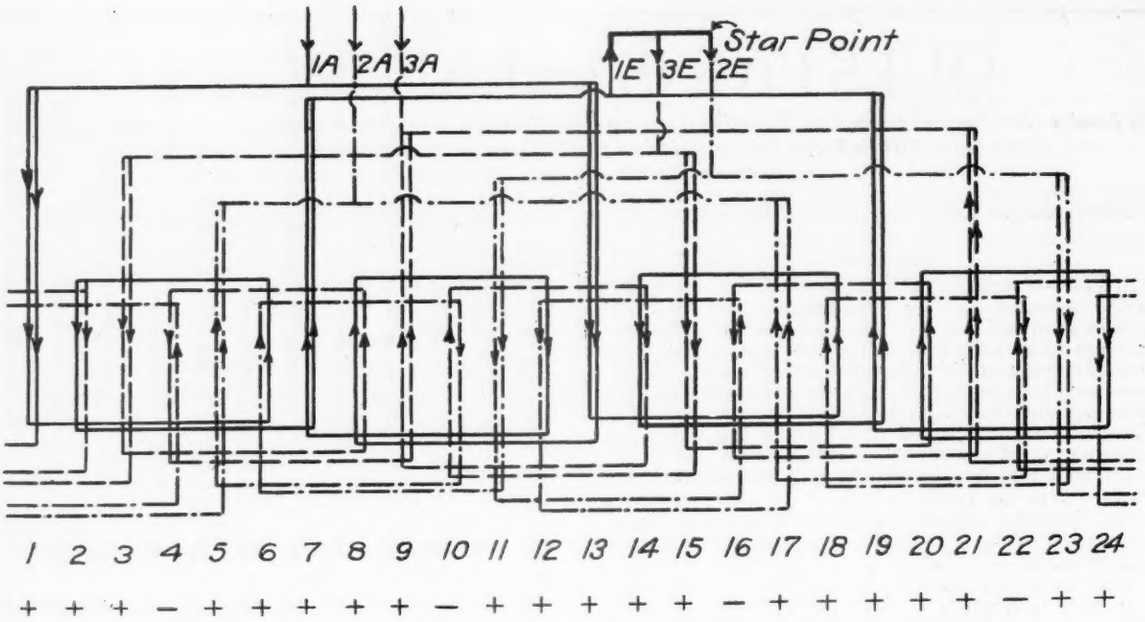


Fig. 1.—Diagram Showing Motor Circuits and Direction of Current at a Particular Instant.

symmetrically situated around the winding the current flows in opposite directions, and that only coils of phases *2* and *3* are in opposition, and as they do not form concentric circuits with each other no effect on the magnetic field results and no undue heating ought to occur. If this does occur the connections must be wrong in some other place, thus unbalancing the magnetic field which results in cross currents through the different groups and causing overheating in the respective parts of the winding.

The short pitch is not responsible for overheating; most motors are wound this way, but it is unusual to have so many coils for such a small motor and so low a voltage. Perhaps the many end connections in this case create an additional

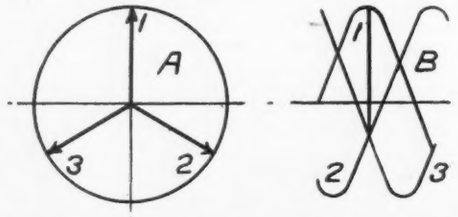


Fig. 2.—Diagram Showing Relation of Current in Various Phases of Motor.

magnetic field in some way which gives rise to heating. These connections should be made in such a way as not to permit a complete circle being laid as close together as the mechanical arrangements in the available space will permit.—M. H., Pittsburgh.

Answer.—It is suggested that the motor be started and run until it is heated to the extent of being uncomfortable to the hand when held on the winding for 30 sec. Then compare the temperature of all the coils around the stator. It is possible that some coils may be grounded or short-circuited out of service as indicated in the accompanying diagram. If any coils are found at lower temperature than the others it is probable that they are out of circuit.—W. M. T., New Orleans, La.

No. 517.—Refinishing Brass Tubing.—Can someone give a good and practical method of refinishing brass

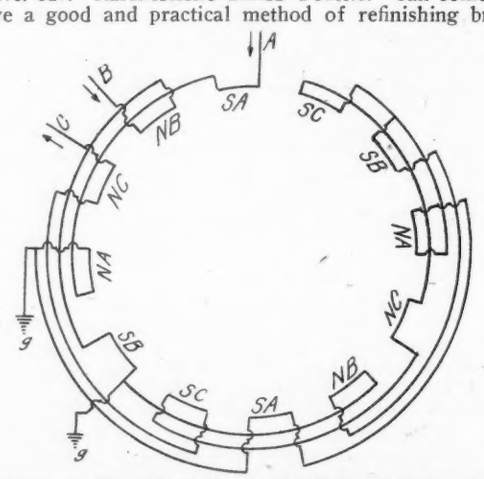


Diagram of End Connections of Motor, Showing Coils Grounded.

tubing and fixture parts? The tubing which I have under consideration at the present time is corrugated.—A. S. N., Plymouth, Mass.

Answer.—In refinishing brass the first thing we wish to know is whether the work is to be done by hand or machine. If done by hand, I suggest that: First, you examine the tubing to see if it has been coated with lacquer. If it has, remove it with a good prepared remover, made for this purpose. Then polish with any metal polish. If you have a buffing wheel at hand better work can be accomplished. You can do more elaborate work if you proceed as follows: Take the tubing and remove all traces of lacquer; dip the tubing in a solution of sulphuric acid 60 to nitric acid 40, adding a tablespoonful of salt to the gallon. If the solution is weak on testing to see if it cuts the tubing, add nitric acid until the desired brightness is secured. If a satin finish is desired, rub up with steel wool or use a scratch brush before polishing. Give a coat of lacquer so that the metal will not tarnish.—J. F. C., Covington, Ky.

APPLIANCES and DEVELOPMENTS

New, Improved or Interesting Electrical and Mechanical Apparatus and Devices, and Applications of Equipment and Methods in Practice

New "King" Transformer of Shell Type Construction.

An addition to the "King" type of transformers has been placed on the market. It is of shell type construction, with a sturdy core and a liberal copper allowance. The case is made in interchanging halves of "Armco" rust-resisting steel, which makes a unique finish, as no japanning is contemplated. The design is neat, the assembly simplified

"King" Transformer of Shell Type Construction.

and the usual filling is eliminated, according to the manufacturer. The transformer complete weighs 1.25 lbs. It is 2.5 by 2.5 by 4 ins., and is wound for any standard voltage or cycles. "King" transformers are now being manufactured under the name of the Electric Heat Control Co., 2711 Church avenue, Cleveland, permission having been granted by the secretary of the state of Ohio to change the name from the Progressive Electric Products Co. This change was deemed necessary so as to eliminate the confusion arising from a duplication of local "Progressive" electric concerns.

Butt Treatment of Cedar Poles by Open-Tank Method.

One of the many interesting papers presented at the 17th annual convention of the American Wood-Preservers' Association at San Francisco, recently was that of W. M. Leavitt, Spokane, superintendent of the plant of Western Red Cedar Pole Preservers, operated at Sand Point, Idaho. This paper, which deals with the butt-treatment of poles by the open-tank method, gives many facts relative to the development of what is known as the Western Red Cedar Association's "B" treatment of pole butts, and describes the mechanical equipment now used in puncturing the sapwood of poles to induce a rapid and uniform penetration of creosote. Mr. Leavitt's paper is as follows:

"Every one here is probably more or less familiar with the development of the open-tank method, but I am going to take the liberty of reviewing the progress made during the past 15 years in the treatment of Western red cedar poles. I believe that the first commercial plant for open-tank treatment of poles was constructed at the Minnesota transfer about 15 years ago. Since that time a large number of plants have been constructed and it is estimated that at least 50% of the poles of 30-ft. length and longer are now butt-treated before being set. Some of the first plants constructed were very crude affairs. About 8 yrs. ago I constructed a plant at Libby, Mont. This consisted of a steel tank 5 ft. diam. set in the ground with an improvised fireplace under it. It cost about $350 complete, and was used to treat several thousand poles, giving them a 15 min. bath in oil heated to from 212 to 230 deg. F. The short-time treatments, regardless of the equipment used, resulted in practically no penetration on most of the poles, and in no case was the penetration sufficiently deep to afford any insurance against abrasions or checks occurring after treatment.

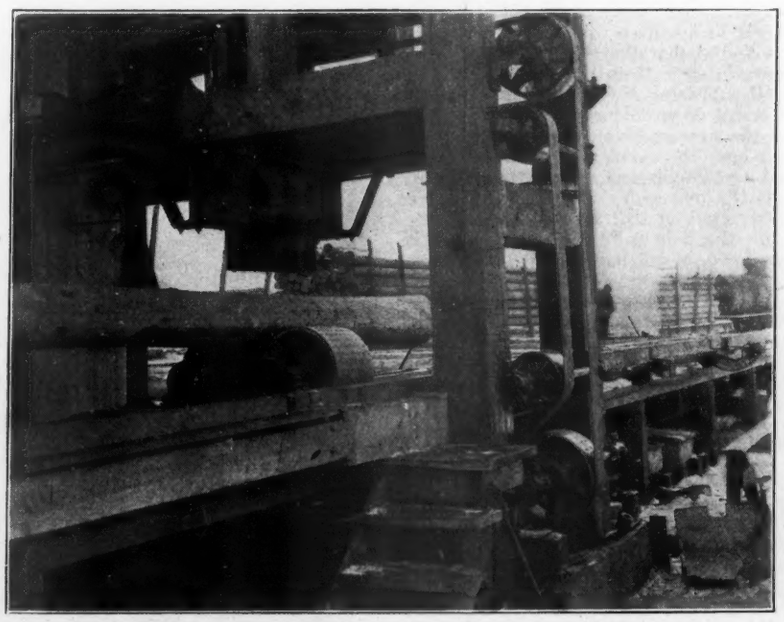
"About 5 yrs. ago, what is now known under the Western Red Cedar Association's specifications as "B" treatment, was put on the market. This treatment consists of immersing the poles for from 4 to 12 hrs. in oil heated to from 212 to 230 deg F. followed by cold oil for from 2 to 6 hrs. A large percentage of the poles treated by this method showed a satisfactory penetration, but it was found by experience, that no matter how well-seasoned the poles were a certain number of them could not be given a satisfactory treatment.

"During the last 18 months, due to an increased volume of business and difficult producing conditions, there have been practically no poles available for treatment that have been cut over 12 mo. It has been found that even an hour's immersion in the hot oil would not discolor a large percentage of these comparatively green poles, and that after 6 hrs. in hot, and 4 hrs. in cold oil, only a small percentage of this class of poles showed a penetration exceeding ⅛ in.

"Some 3 yrs. ago one of our members conceived the plan of securing a penetration by puncturing the sapwood of the poles with short steel points. He used a rubber belt 8 ins. wide and 3 ft. long, and arranged the points so that a perfect penetration would be obtained if the oil traveled lengthwise of the poles 2.5 ins. and crosswise for a distance of ⅛ in. This was a distinct improvement, and since that time a number of treating plants have been puncturing all poles for treatment by the "B" method. Difficulty was experienced, however in getting sufficiently deep puncture as the points had to be driven in with wooden hammers, and as this work was done by hand there was no assurance that it was being properly performed.

"Then, 2 yrs. ago there were shipped to the Sand Point treating plant for experimental purposes one carload of green poles, one carload of poles that had been seasoned 12 mo., and one carload of poles that had been seasoned over 2 yrs. Several members of our Association, who were interested in treating, spent nearly a week at Sandpoint on these experiments. The conclusion drawn from these experiments may be summarized as follows:

(1) That, if the sapwood was properly punctured, a full sap penetration



Puncturing Machine in Use at Plant of Western Red Cedar Pole Preservers, Sand Point, Idaho.

could be obtained in either a green or a seasoned pole.

(2) That, it was impossible by the use of steel points in a belt to puncture the sapwood of a pole in a proper and uniform manner.

(3) That, where poles were not punctured there was no uniformity of results on either seasoned, partly seasoned or green poles. A considerable difference in the depth of penetration obtained was often found on the same pole. Very few of the green poles, or poles cut 12 mo. or less, showed a penetration of over ⅛ in.

"It was evident that if satisfactory penetration was to be secured a machine must be built that would give any depth of puncture desired and any desired spacing of the puncture points. These were particularly important in order that the wood fiber be lacerated as little as possible and at the same time secure a complete impregnation. Such machine, it was decided, must be mechanically operated so that it may be as free as possible from human error and inefficiency.

"A machine was placed in operation about May 1, 1920, and since that time practically all poles treated at the Sandpoint plant by the "B" method have been punctured with it. It was found however, that a number of improvements must be made and we immediately started building another machine which went into operation about Nov. 1.

"The puncturing is done by 42 iron bars 4.5 ft. long, 3 in. wide, 0.75 in. thick, and weighing approximately 37 lbs. each. Each bar is equipped at the bottom end with a detachable point holder so that the depth and the spacing of the puncture can be regulated. Each bar works independently of all the other bars in order to take care of the irregularities of the pole. These bars are raised by cams and drop by gravity, the machine being constructed so that the operator can regulate the distance that the bars drop by simply raising or lowering the hoist on which the pole rests. The pole is transported under the bars by live rolls and then raised into position by hoists. On the first machine the part of the pole that was to be punctured was supported by two wheels 24 ins. diam. and 4 ins. wide. It was found that the weight of the bars, approximately 1500 lbs., dropping on so small a bearing surface had a tendency to break down the sapwood. In building the new machine this difficulty was overcome by replacing these wheels with two oscillating wheels 24 ins. diam. and 18 ins. wide. These wheels are constructed so that no matter what position the pole is in, or what taper it may have, it will have a full 18-in. bearing surface.

"At the present time 0.5-in. chisel-shaped points, spaced so that if the oil travels 1.5 ins. lengthwise of the pole and 0.125 in. crosswise a complete penetration will be obtained, are being used. Careful observation during the past 8 mo. would indicate that the spacing should be regulated by the amount of free oil it is desired to inject into the average pole, assuming, as I think we can, that weather conditions and the question of whether poles are seasoned, partly seasoned or green, will be taken care of by the duration of treatment given the material.

"It is impossible by this method to put a given amount of oil into a certain area of sapwood. One pole may have only a slight impregnation which may not be visible for several weeks, while another pole in the same treatment, or the opposite side of the same pole, may be saturated at the end of the treatment. It is not unusual to find in the unpunctured area a complete sap penetration on one side of the pole and less than 0.25 in. on the opposite side.

"During the month of December a car load of green poles was shipped into the plant for experimental purposes. Most of those poles were given a 10-hr. treatment, 6 hrs. hot and 4 hrs. cold. These poles were tested with an increment borer and then the treated area of eight of them sawed and split up. Not one of the poles that was tested showed any penetration whatever in the unpunctured area. The poles that were split showed the oil had not traveled to exceed 0.5 in. from the puncture at the time they were taken from the treating tank. These poles were shipped into Spokane, Wash., and laid away for observation. It was found that there was no uniformity in the travel of the oil from the puncture holes. In sections of some poles the oil traveled as much as 12 ins. lengthwise of the pole in 24 hrs., and in one case, over 2 ft. in 2 wks., while in another section of the same pole it did not average 2 ins. a week. It was impossible to observe any difference in the rate of travel whether the oil was moving towards the top or towards the bottom of the pole.

"The time at which a complete impregnation may be observed varies from the time the pole is removed from the treating tank up to 2 mo. after the time of treatment. In a properly punctured pole we have not, however, had a single instance where we did not eventually secure a complete impregnation to the depth of the puncture, providing the puncture did not enter the heart wood.

"It remains to decide what depth of penetration is necessary or desirable and the amount of free oil that should be put into the average pole. When we decide these questions I believe we shall be able to determine the length of point and what spacing is best to use to secure results which will work out to the satisfaction of all concerned."

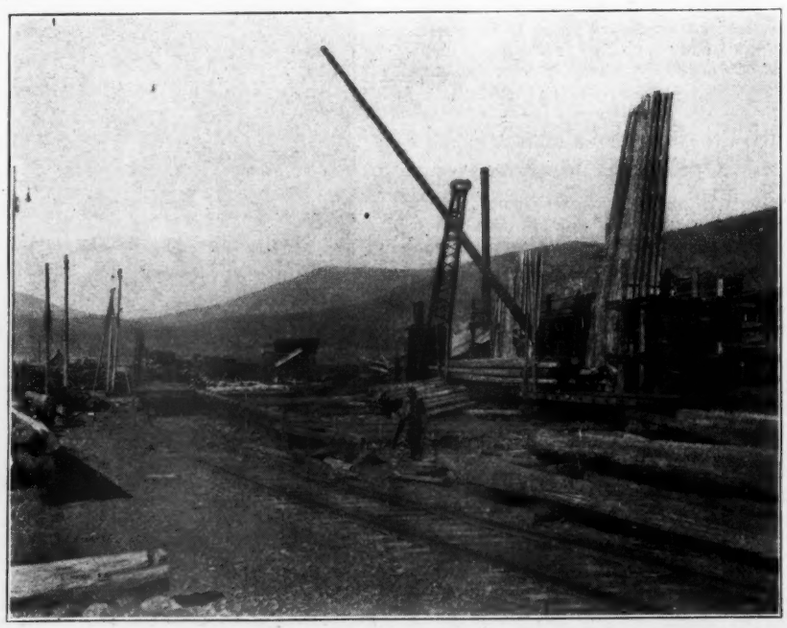
New Type of Jiffy Tap and Double Duty Plug.

The Esler Electric Manufacturing Co., Marion, Ind., has recently placed on the market its type "T" Jiffy tap. This is similar to other Jiffy taps which have been on the market for some time, except that it is made to fit attachment plugs with tandem blades. This new type of Jiffy tap provides double service from a single receptacle having tandem or "I" slots and makes a neat job. The prongs of the attachment plug pass through the slots of the Jiffy tap and make connection with the contact strips on the tap, which are connected to the screw shell socket.

Jiffy Current Tap.

The Jiffy double duty plug has been recently brought out by the company for the purpose of completing its "full line for double service." It is for use with all standard sockets. The plug shell is riveted directly to each socket shell in two places and the center contacts are all in one piece. The insulating parts are made of vulcanized fiber and are so designed that they furnish additional strength to the device. The maker states that the double service plug is neat and strong, but light in weight, and there are no porcelain parts to break.

Jiffy Double Service Plug.



Pole-Treatment Plant of Western Red Cedar Pole Preservers, Sand Point, Idaho.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Ohio Brass Co., Mansfield, O., has issued its catalog No. 18, covering high-tension insulators, trolley-line materials, rail bonds and tools, third-rail insulators, car-equipment specialties, etc.

Ideal Electric & Manufacturing Co., Mansfield, O., has announced the appointment of Arthur Purdon as general sales agent for the Utah territory, with offices at 615 Newhouse building, Salt Lake City.

Wright Manufacturing Co., Lisbon, O., maker of the "Wright" high-speed hoists, steel trolleys, screw hoists, etc., has issued a booklet pertaining to the high-speed hoist for garage, automobile shop and other uses.

Central Engineering Co., Davenport, Ia., has increased its capital stock from $100,000 to $200,000. The company has secured larger quarters in the Putnam building, where it has been located for a number of years.

Newark Electrical Supply Co., 223 Market street, Newark, N. J., held its first merchandising and sales convention and banquet last month, the object of which was to launch a statewide campaign for co-operation between electrical jobber and contractor-dealer. O. Frederick Rost, general manager, presided. P. B. Zimmerman, National Lamp Works of General Electric Co., discussed the development of lamps with a comparison of lighting conditions today and 10 yrs. ago and the remarkable lead the United States had over England with two lamps per capita against one-quarter. Other speakers included the following: A. Hansen, Hotpoint Electric Heating Co.; Sam T. White, White Lily Manufacturing Co.; C. J. James, Electric Vacuum Cleaner Co.; R. P. McConnell, Rutenber Electric Co.; George E. Loomis, Walker Dishwasher Co.; V. G. Kay, Bell Washer & Wringer Co.; G. E. Voorhees, N. G. McFaddin & Co.; J. L. Mayer, American Ironing Machine Co., and W. L. Goodwin.

Cutler-Hammer Manufacturing Co., Milwaukee, manufacturer of electric controlling devices, held a general sales meeting during the week of Feb. 14-19 under the direction of W. C. Stevens, sales manager of the firm. The office managers of the several district offices of the company were in attendance.

American Insulator Corp., New Freedom, Pa., has announced the appointment of the Albert J. Cox Co., 564 West Monroe street, Chicago, as its sales representative in the states of Illinois, Indiana, Missouri, Iowa, Minnesota and Wisconsin. The Albert J. Cox Co. will handle the "Aico" line of products, consisting of cold molded insulating parts for electrical and automotive units.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, has recently issued leaflet No. 1933, called "Sectional Individual Motor Drive for Paper Machines." This leaflet describes and illustrates the sectional individual motor drive, which has been successfully developed by the Westinghouse Electric & Manufacturing Co., to assure increased production, decreased maintenance, greater reliability and durability in machines for the production of paper.

L. E. Wooten Co., Inc., 277 Broadway, New York City, has announced the purchase of the stock of the William B. Durgin Co., Concord, N. H., and the manufacture of Crawford induction motors will be continued under the name of the Crawford Manufacturing Co., which has been incorporated in New Hampshire with a capital stock of $150,000. The officers are: President, L. E. Wooten, New York City; vice-president, John J. Crawford, Concord, N. H.; secretary and treasurer, P. L. Gill, New York City, and clerk, C. R. Blanchard, Concord, N. H.

Banquet Concluding Merchandising and Sales Convention Held by Newark (N. J.) Electrical Supply Co.

Franklin Specialty Manufacturing Co., Providence, R. I., has filed notice of change of name to the Localized Lighting Corp.

Electric Equipment Co., Reading, Pa., formerly at 225 North Fifth street, has changed its address to 322 North Sixth street.

Phoenix Lighting Fixture Co., New York City, has filed notice of increase in its capital stock from $5000 to $50,000 for proposed expansion.

Mutual Lamp Manufacturing Co., 21 East Houston street, New York City, sustained a loss by fire last month, a portion of the plant, machinery and stock, being destroyed.

Foote, Pierson Co., Inc., 160 Duane street, New York City, manufacturer of electrical supplies, sustained a loss by fire recently, a portion of the works, including machinery and stock, being destroyed.

Hazard Manufacturing Co., Wilkes-Barre, Pa., manufacturer of electrical wires, cables, etc., has opened a sales office and warehouse at 1701 First avenue, Birmingham, Ala., in charge of R. J. Bravand, district manager.

Maring Wire Co., Muskegon, Mich., manufacturer of enameled and cotton-covered magnet wire, has announced the appointment of H. A. Strickland, 844 Book building, Detroit, as its sales representative for the state of Michigan.

Fairbanks, Morse & Co., 30 Church street, New York City, manufacturer of engines, motors, etc., will continue its plant expansion program, inaugurated some months ago, and complete the erection of a number of buildings at its plants.

Conveyors Corp. of America, 326 West Madison street, Chicago, has announced that the Power Equipment Co., 131 State street, Boston, has been appointed as New England representative for the sale of its American trolley carrier, monorail equipment for handling coal, ashes, sand, gravel and other loose bulky materials. Colwell & McMullin, 79 Milk street, Boston, are the New England representatives for the American steam ash conveyor made by the Conveyors corporation.

Progressive Electric Products Co., 2711 Church avenue, Cleveland (under which name the King Electric & Manufacturing Co. was incorporated) has been granted permission by the secretary of the state of Ohio to change its name to The Electric Heat Control Co. The company advises that this was done to eliminate the confusion existing in both mail and deliveries, on account of there being too many local "Progressive Electrics." "King" transformers will be manufactured exclusively by the above company.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

EDWARD M. GRAHAM, vice-president and general manager of the Bangor Railway & Electric Co., Bangor, Me., has been elected president of the company.

DR. WILLIAM MCCLELLAN has resigned as vice-president of the Cleveland (O.) Electric Illuminating Co., which position he has held for nearly 2 years.

W. H. HODGE, publicity manager of H. M. Byllesby & Co., Chicago, addressed the Oklahoma City Advertising Club last month on the subject of "Power of Advertising."

E. M. NEWLIN, until recently with the Northern States Power Co., Minneapolis, Minn., is now with the U. S. Government in the Eastern Industrial Superpower Survey.

EZRA B. WHITMAN, Baltimore, has been tendered an appointment as a member of the Public Service Commission by the governor, to fill the vacancy caused by the death of James C. Legg.

W. A. PORTERFIELD, Dallas, Tex., who has been connected with the engineering department of the General Electric Co., has been appointed general sales manager of the Union Metal Manufacturing Co., Canton, O., to succeed C. L. Eshleman, who has resigned.

F. A. WILSON-LAWRENSON, sales director of the American Ever Ready Works, entertained at dinner Feb. 24, in the William Penn Hotel, Pittsburg, over 50 "Eveready" jobbers and dealers of that territory. Marcus Regan, merchandising counsel for the company, outlined the sales plans for 1921, while the first public showing of the 2-reel moving picture film, "Making of Flashlights," was given.

F. A. Wilson-Lawrenson.

LAWRENCE W. WALLACE has been elected secretary of the American Engineering Council to succeed L. P. Alford. The Council's New York City quarters are located in the Engineering Societies building.

THOMAS A. EDISON, with Mrs. Edison, celebrated the 35th anniversary of his residence at Llewellyn Park, West Orange, N. J., Feb. 26. An informal reception was held. The home is known as "Glenmont."

W. J. GILSON has resigned as superintendent of the Northern division of the Houghton County Electric Co., Houghton, Mich., to accept a position with the Adirondack Light & Power Corp., Glens Falls, N. Y.

H. P. BROUGHTON, formerly manager of the Interstate Public Service Co., Kentland, Ind., has succeeded Charles B. Hart as superintendent of the light and power department of the Indiana Service Corp., Fort Wayne, Ind.

HOWARD W. MAXHAM has resigned as superintendent of automotive transportation with the American Bosch Magneto Corp., Springfield, Mass., to take charge of the maintenance department of Gray & Davis, Inc., Amesbury, Mass.

PAUL W. KUNNING, now acting as commercial agent of the Chicago district office of the U. S. Bureau of Foreign and Domestic Commerce, has been apointed foreign trade adviser in the interstate and foreign trade department of the Chicago Association of Commerce.

CLIFFORD F. MESSINGER, general sales manager of the Chain Belt Co., Milwaukee, was elected president of the Concrete Mixer Association of the United States at the annual election of officers of that organization held in Chicago recently.

J. L. GASTON, of the Union Light, Heat & Power Co., Covington, Ky., has been made chairman of the New-Business Co-operations Committee, Lighting and Merchandising Section of the Ohio Electric Light Association, to succeed M. H. Lytle.

HARRY BOGART, of the Norman (Okla.) division of the Oklahoma Gas & Electric Co., won the January prize offered by the company's securities department for the largest single sale of Oklahoma Gas & Electric Co. preferred stock during the month.

A. A. RANSOM, who was formerly connected with the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., as export sales engineer, has resigned to become general superintendent of the Olympia Light & Power Co., Olympia, Wash.

F. C. FOSTER, who has been sales manager of the Buckeye Electric Division, National Lamp Works of General Electric Co., Cleveland, since 1916, has just assumed the position of director of sales with the Laundryette Manufacturing Co., Cleveland, maker of the "Laun-Dry-Ette" washing machine. Mr. Foster had been with the Buckeye organization for years, starting in as a salesman and being later appointed manager of the Pittsburgh office, coming to Cleveland in 1916 as sales manager. He is well known throughout the electrical industry, particularly in the country home lighting-plant field. The Laundryette Manufacturing Co. is now in its sixth year of making the "Laun-Dry-Ette" and has only recently increased its capacity by the addition of a new factory unit.

F. C. Foster.

OBITUARY.

CHARLES B. SCHOENMEHL died Feb. 14 at his home in Waterbury, Conn. He was president and treasurer of the Waterbury Battery Co. and of Charles B. Schoenmehl, Inc., and was formerly connected with the tube department of the American Brass Co.

WILLIAM R. HOLLIGAN, formerly chief of the operating department of the Western Union Telegraph Co. and later city superintendent of the Postal Telegraph-Cable Co. in Chicago, died Feb. 28 in New York City, where he had resided since 1905. He was 57 yrs. of age.

A. H. REECE, whose death was recently announced, was connected with the electrical industry for many years. At one time he was district manager in Atlanta, Ga., for the General Electric Co., and was also connected with the St. Louis office of that company for some time. He left the electrical business about 1896 or 1897 and came to Chicago, where he established the Solarine Co., manufacturer of metal polish, being president of that company until the time of his death.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Augusta, Me.—The Central Maine Power Co. will build a substation at this place.

Bar Harbor, Me.—The Bureau of Yards and Docks, Washington, D. C., will soon break ground for a new building at the local radio plant. Bids for construction have been taken.

Portland, Me.—Considerable electrical equipment will be installed in the new plant to be erected at Portland at an estimated cost of $150,000 by the William Underwood Co., 50 Fulton street, Boston, manufacturer of canned goods.

Franklin, N. H.—The Moores Falls Co., recently organized, has preliminary plans under way for construction of a hydroelectric power plant at Moores Falls on the Merrimac river, near Manchester, N. H., estimated to cost in excess of $750,000. The company is headed by Herman F. Straw, Walter M. Parker and Frank S. Carpenter, all of Manchester; and A. S. Sulloway, Franklin.

Rutland, Vt.—The Rutland Railway, Light & Power Co. is doubling the capacity of its city power lines with the installation of a new system to provide for increased power supply. The company is changing all of its 25-cycle distribution at West Rutland to 60-cycle service. A change-over is also being made in the service for direct current.

Springfield, Vt.—Electric motors and considerable electrically operated machinery will be installed in the 2-story machine shop, 50 by 150 ft., to be constructed by Gilman & Son, operating a local machine works.

Brockton, Mass.—The Edison Electric Illuminating Co. has been granted permission by the Department of Public Utilities to issue stock to the value of $516,600, the proceeds to be used in part for extensions and betterments in electric power plant and system.

Hartford, Conn.—The Connecticut River Co., 50 State street, is arranging for the construction of a hydroelectric generating plant on Kings Island in the Connecticut river, near Windsor Locks, Conn. The proposed plant will have a capacity of about 32,000 hp., with dam to be constructed 30 ft high and about 2000 ft. long. Application for permission to build the plant has been made to the Federal Power Commission.

Hartford, Conn.—The Hartford Electric Light Co. is planning the early occupancy of its power plant now being erected at a cost of about $5,000,000. In a recent report it is set forth that the assets of the company have grown from $9,965,000 to $19,107,500.

Newport, R. I.—Electrical equipment, heating and ventilating apparatus, etc., will be installed in the addition to be built to the Rogers High School, Broadway, estimated to cost $450,000. The Board of Aldermen, City Hall, is in charge.

Binghamton, N. Y.—The Public Service Commission has granted permission to the Binghamton Light & Power Co. to increase its rate $0.0175 per kw-hr. for all residential and commercial lighting service.

Brooklyn, N. Y.—Considerable electrical machinery, refrigerating and ice-manufacturing equipment will be installed in the plant to be erected on Tilden avenue, by Rubel Brothers, Glenmore avenue and Junius street, at an estimated cost of $500,000.

Brooklyn, N. Y.—The Yebo Yacht Basin Co., foot of 24th street, has received a contract from the United States Shipping Board for the installation of a new electric drive and other electrical equipment in the vessel, "Archer," replacing war emergency gears. The work will cost about $83,300.

Buffalo, N. Y.—Considerable electrical equipment will be installed in the proposed plant addition to be constructed by the Wickwire-Spencer Steel Corp., River road, estimated to cost in excess of $1,000,000.

Campbell, N. Y.—Engineer W. S. Lezie, Cutler building, has prepared plans for hydroelectric development. Address J. W. Aulls, Campbell, N. Y.

Cohoes, N. Y.—The Cohoes Power & Light Corp. has arranged for a bond issue of $725,000, the proceeds to be used in part for proposed extensions and betterments in electric power plant and system.

Granville, N. Y.—The Telescope Cot Bed Co., 535 East 79th street, New York City, manufacturer of metallic bedsteads, will build a power house in connection with its proposed new local factory, estimated to cost $100,000. Russell G. Cory, 50 Church street, New York City, is engineer.

Long Beach, N. Y.—The Long Beach Power Co., Park street, has completed plans for the construction of a 1-story power plant addition, to cost about $125,000 with machinery.

Long Island City, N. Y.—The Astoria Light, Heat & Power Co., 130 East 15th street, New York City, has filed plans for the erection of a one-story purifier plant, 47 by 277 ft., on Winthrop avenue, near Van Alst avenue, to cost about $80,000.

Maspeth, L. I., N. Y.—Considerable electrical machinery will be installed in the plant to be erected at Grand avenue and Harrison street, Maspeth, by the United States Industrial Alcohol Co., 27 William street, New York City, estimated to cost $500,000.

New York, N. Y.—The New York Edison Co., Irving place and 15th street, has secured a contract for light and power service at the Standard Oil Co. building, 26 Broadway, with discontinuance of isolated plant heretofore operated for this purpose. The installation comprises about 6000 lamps, house pumps, elevators, etc.

New York, N. Y.—Electrical equipment will be installed in the 2-story foundry, to be erected by the White Fuel Oil Engineering Co., at 732-38 East 12th street, estimated to cost $75,000.

New York, N. Y.—Electrically operated machinery for hoisting, conveying, etc., will be installed at the concrete coal pocket to be constructed by Sinram Brothers, 910 East Fifth street, on waterfront property on the East river, near 37th street, recently acquired.

Syracuse, N. Y.—In connection with its large plant addition, now nearing completion, the Franklin Automobile Co. will establish a new power plant for general works service, estimated to cost $500,000, including machinery.

Atlantic City, N. J.—Considerable electrical equipment will be installed by the Atlantic City Tire & Rubber Co., 3304 Atlantic avenue, at its proposed automobile tire manufacturing plant on North Georgia avenue, estimated to cost close to $70,000.

Dover, N. J.—The New Jersey Power & Light Co. has completed the construction of a power line from Sparta Junction to Hamburg, operating at 33,000 volts. The transmission system will be used to furnish power to a number of industrial plants in this section, as well as for commercial and residental lighting service in certain districts. The company has rebuilt a large portion of its lines in the Bernardsville section, as well as portions of the primary and secondary system in the vicinity of Hercules Park, Kenvil, N. J.

Metuchen, N. J.—Considerable electrical machinery and operating equipment will be installed in the proposed addition to the local plant of the General Ceramics Co., comprising a 1- and 2-story building, 165 by 785 ft., estimated to cost $400,000 with equipment. Dietrich Wortmann, 116 Lexington avenue, New York, is architect. The company headquarters are at 50 Church street, New York City.

Newark, N. J.—Considerable electrical equipment, heating and ventilating apparatus, mechanical fans, etc., will be installed by the Board of Education in a number of new school buildings as follows: Miller street school, $400,000; Coes place and Market street, $240,000; Elizabeth avenue, $100,000; Hawkins avenue, $500,000, and Abington avenue, $350,00.

Trenton, N. J.—The Trenton & Mercer County Traction Co. is plan-

ning improvements to cost about $300,000 during the coming year. The work will require considerable electrical equipment, including wire, poles, etc.

Woodbridge, N. J.—The Woodbridge Lighting Commission is negotiating with the Public Service Electric Co., for a consolidation of the different lighting districts in the townships, forming one district instead of seven as now. With this change it is proposed to make improvements in the system, increasing the lamps from 25-watt to 60-watt units, and other work.

Doylestown, Pa.—The Bucks County Chamber of Commerce, recently organized, has tentative plans under way for the utilization of water power from the Delaware river in this section with the establishment of a hydroelectric power plant for light and power service in different sections of the county. Thomas B. Stockham, Morrisville, Pa., is president; Frank L. Muschert, Morrisville, is secretary.

Harrisburg, Pa.—The city council has approved an ordinance providing for the purchase of equipment for the installation of an underground conduit system in Walnut and Susquehanna streets. Other measures have been authorized providing for the installation of streets lamps in the 15th ward, and for the installation of fire alarm boxes in this same district.

Hummelstown, Pa.—The Hummelstown Water & Power Co. has plans under way for the erection of a 1-story, electrically operated filtration plant to cost about $35,000.

Philadelphia, Pa.—The Department of City Transit, 1211 Chestnut street, will soon take bids for the construction of a 1-story and basement substation at Front street and Fairmont avenue, in connection with other structures to be built at this location. W. S. Twining is director.

Philadelphia, Pa.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is arranging for the installation of an electric distributing system at the local navy yard.

Pittsburgh, Pa.—The Bell Telephone Co. of Pennsylvania has awarded a contract to the W. T. Grange Construction Co., Pittsburgh, for the erection of an automatic exchange station at Rural and Highland avenues, East End, 102 by 126 ft., to cost about $350,000. This will be the first automatic exchange plant to be erected in the city.

Scranton, Pa.—The Sheffield Township Electric Co. has been incorporated with a capital of $5000 to operate a local light and power system. E. H. Ramsbotham, Scranton Life building, is treasurer.

Wilkes-Barre, Pa.—The Wilkes-Barre Co., 25 North Main street, is considering the construction of a power line in the vicinity of Empire and Blackman streets.

York, Pa.—The city council is arranging a bond issue for $1,000,000 for municipal extensions and improvements, to include the enlargement of the present sewerage disposal plant and the installation of new electrically operated machinery.

York, Pa.—Fire on Feb. 12 destroyed the transformer station and tool house of the Delta Lighting & Power Co., with loss reported at about $10,000.

Baltimore, Md.—Considerable electrical equipment will be installed in the proposed group of buildings to be erected by the Union Memorial Hospital in the University Parkway district. The board of directors is having plans drawn for the structures.

Berwyn Heights, Md. — The Berwyn Heights Association is negotiating with the local electric light and power company for the installation of an electric system throughout this section. The work will include a system for domestic and commercial service. Charles Stein, chairman of the light committee, is in charge.

Port Covington, Md.—Considerable electrical machinery, including hoisting and conveying apparatus, coal-handling equipment, etc., will be installed at the new coaling pier extensions of the Western Maryland Railway Co., Baltimore, at Port Covington. The new plant is estimated to cost $250,000.

Westminster, Md.—A power plant will be constructed in connection with the group of buildings now being planned by the board of trustees of Western Maryland College. The entire project is estimated to cost $1,000,000.

Remington, Va.—The Electric Light & Power Co. has been incorporated with a capital of $25,000 to succeed the Electric Power & Milling Co. A. L. Hord is president of the new company.

Christianburg, W. Va.—The Coalton Coal Corp., recently organized, is planning the installation of electrical equipment, mining machinery, etc., at its properties near Williamson, W. Va. An aerial tramway will be constructed. J. T. Jones, Cambraia, Va., is secretary and treasurer.

Huntington, W. Va.—The Consolidated Light, Heat & Power Co. has applied for a franchise to erect, maintain, etc., transmission lines for power and lighting.

Shinnston, W. Va.—The borough council is planning the construction of an electrically operated pumping plant in connection with a new filtration works. The Roberts Engineering Co., Charleston, W. Va., is engineer.

Columbia, N. C.—Bonds to the amount of $10,000 have been voted for an electric light system. Address the mayor.

Connelly Springs, N. C.—The Connelly Springs Light & Power Co. has been incorporated with a capital of $25,000. R. R. Ennis is interested.

Pollocksville, N. C.—Bonds to the amount of $35,000 have been voted for a light and water plant. Address the mayor.

Newberry, S. C.—Bonds to the amount of $18,000 have been voted for an electric light system. Address the mayor.

Cordele, Ga.—The city will construct a light and power plant in connection with its water plans. Bonds to the amount of $40,000 will be voted on for this purpose. Address J. Gordon Jones, mayor.

Lyons, Ga.—The city will build concrete dam across Pendleton creek to generate electricity for lighting and commercial purposes. The project is estimated to cost $1,000,000. Address the mayor.

Nocatee, Fla.—The Nocatee Ice & Power Co. has been incorporated with a capital of $5000. F. R. McConnell is interested.

Fort Pierce, Fla.—An election will be held March 15 to vote on the question of issuing $60,000 in bonds for the improvement of the municipal light and power plant.

NORTH CENTRAL STATES.

Ansonia, O. — Water and light bonds to the amount of $30,000 have been voted by the city. Address the mayor.

Lima, O.—Bonds to the amount of $160,000 have been voted for extension to the boulevard lighting system.

St. Joseph, Mich. — The Board of Public Works plans to install curb-lighting system.

Delphi, Ind.—The Farmer's Co-operative Packing Co. plans to construct an electric power plant in connection with its new packing works to cost about $500,000.

Paoli, Ind. — The Paoli Water & Light Co. has been incorporated with a capital of $75,000, the directors being C. C. Johnson, R. M. Case and Raymond Stout.

Danville, Ill.—A boulevard lighting system for Vermilion street has been approved. Address E. K. Wolgamot, president of the commission.

Danville, Ill.—The proposition to install ornamental lamps in the downtown district, which has been considered by the city council, will be discussed by the board of local improvements. Address Secretary Gordon.

Taylorville, Ill.—The city will begin work shortly on its new municipal lighting plant. Address city clerk.

Manitowoc, Wis.—The city plans to enlarge power plant and extend the transmission line. Address H. Groth.

Merrill, Wis.—The city council has authorized the installation of an ornamental street-lighting system, at an estimated cost of $30,000. Address Harry R. Allen, city clerk.

Oconomowoc, Wis.—City officials contemplate installing a switchboard in the municipal lighting plant and in outside substation. Address T. S. Johnson, city clerk.

Blue Earth, Minn.—A transmission line will be constructed to supply light and power to Ceylon and Dunnell. Address Easton Flee, city clerk.

Fergus Falls, Minn.—A transmission line will be erected to Rothsay. Address C. S. Kennedy, Otter Trail Power Co.

La Crescent, Minn.—The city will install 12 additonal street lamps. Address J. A. Lilly, city clerk.

Minneiska, Minn.—The town will build an electric service line from

Kellogg to this place. Address Wisconsin-Minnesota Light & Power Co.

Storden, Minn. — Plans are being considered for the purchase by the city of an electric light and distributing system. Address the mayor.

West Duluth, Minn. — Architect Francis H. Fitzgerald is preparing plans for the Duluth Edison Electric Co.'s transformer station to be built in West Duluth.

Corning, Ia.—A municipal electric light plant will be erected here. Address W. C. Chubb, city clerk.

Griswold, Ia.—The city will erect a power plant at an estimated cost of $50,000, bonds for which will be issued.

Troy Mills, Ia.—Plans have been prepared by Holland, Akerman & Holland, engineers, 106 East Liberty street, Ann Arbor, Mich., for improvements to the local power house. Address Natural Research Development Co.

Excelsior Springs, Mo. — The Excelsior Springs Water, Gas & Electric Co. is planning the construction of a transmission line to Library, Mo.

Fulton, Mo.—The city will vote in April on the question of issuing $75,000 in bonds to enlarge and improve the local light and water plants. Address the mayor.

Independence, Mo.—The city council has plans under way for the erection of a municipal electric light and power plant. Black & Veatch, 701 Mutual building, Kansas City, Mo., are engineers.

Kansas City, Mo.—A special election will be held April 7 to vote bonds for the establishment of a municipal light and power plant, and extensions in waterworks, to the amount of $1,050,000. L. H. Chapman is commissioner of light and water.

Linn Creek, Mo. — The Missouri Water Power Co., recently organized with a capital of $550,000, is planning the construction of a hydroelectric power plant on the Niangua river. S. C. Roach is head.

Moberly, Mo.—Considerable electrical equipment will be installed in the proposed municipal waterworks system extensions, estimated to cost $350,000. The city council is in charge.

Mountain Grove, Mo.—The Mountain Grove Creamery, Ice & Electric Co., with factories at Mountain Grove and Carthage, Mo., will erect a plant at Birmingham, Ala., at an estimated cost of $150,000.

St. Louis, Mo.—The United Railways Co. plans to erect four electric plants for traction service.

Wheaton, Mo.—The Wheaton Light, Ice & Cold Storage Co., has been incorporated with a capital of $40,000. W. A. Davidson is interested.

Arlington, Kan.—Additional electric light bonds to the amount of $20,000 have been voted by the city. Address the mayor.

Colby, Kan.—The city has voted $60,000 in bonds for improvements to its electric lighting plant. It is planned to install probably two 175-200-hp. horizontal return tubular boilers; two 175-200-hp. simple non-condensing Corliss type engines, direct connected to 2300-volt, 3-phase, 60-cycle generators, with complete boiler room accessories, feed water heaters, motor-driven boiler feed pumps, motor-driven deep well pump and complete switchboard equipment. Clarence E. Reid, Manhattan, Kans., is engineer.

Minneapolis, Kan.—An election will be held April 5 to vote on the question of issuing $60,000 bonds for the erection of an electric light plant. Address city clerk.

Wilsey, Kan.—The city is issuing $18,000 in bonds for an electric lighting system. It is planned to build a 6600-volt transmission line to Council Grove, Kan., about 11 mi. away, and a city distributing and street-lighting system. Clarence E. Reid, Manhattan, Kan., is engineer.

Elk Point, S. D. — Bonds to the amount of $20,000 have been voted for the purchase of new engine and other equipment at the city power plant. Address the city clerk.

Ramona, S. D.—The town will build a power line from Madison, S. D., to this place.

Worthing, S. D. — The Worthing electric light plant was damaged by fire recently.

SOUTH CENTRAL STATES.

Kuttawa, Ky.—The Kuttawa Water & Light Co. and the Cumberland Electric Co. have been taken over by the Public Service Co., recently organized for this purpose. The new organization is planning the erection of a power plant for increased production, with extensions in distributing lines. G. P. Ordway is president.

Paducah, Ky.—The Paducah Electric Co. is planning the erection of an addition to its power plant, with remodeling of present structure. A new turbogenerator will be installed, as well as switchboard and considerable other equipment. The work is estimated to cost $200,000. Line extensions and other improvements will be made to cost about $50,000. Stone & Webster, 147 Milk street, Boston, are engineers for the project. Alfred S. Nichols is manager.

Jackson, Tenn.—The commissioner of streets and highways is arranging for the installation of a new lighting system in Courthouse square. Paul M. Wilson is head of the department.

Memphis, Tenn.—The city council is receiving bids for the construction of a municipal electric light and power plant.

Montgomery, Ala. — The Alabama Power Co. has filed with the Alabama Public Service Commission application for certification of necessity and convenience to build a transmission line from Roanoke to Lafayette, also to build another unit of 19,500 hp. at its hydroelectric plant to Lock 12 on the Coosa river.

Jackson, Miss. — The Mississippi State Penitentiary will install electric light at Camp B, O'Keefe farm. Address J. J. Coman, secretary.

Alexandria, La.—The Gravity Canal Co. is planning the construction of a dam and the erection of a hydroelectric power plant near the head of Bayou Cocodrie. Application for permission to carry out the project has been made to the Federal Water Power Commission.

Houma, La. — The city will vote March 15 on the question of issuing $180,000 bonds to construct combined electric light, waterworks and filtration plant. Address H. M. Bourg, mayor.

Monroe, La.—Bonds to the amount of $140,000 have been voted for an electric light and waterworks. Address Arnold Bernstein, mayor.

Shreveport, La.—The Union Power Co. plans to construct a number of electric generating plants in the Monroe (La.) gas fields.

Cotter, Ark.—The Dixie Power Co. will erect a power plant on the White river. Address Walker V. Powell, president.

Ballinger, Tex. — The city council has arranged for a fund of $60,000 for the construction of a municipal electric light and power plant.

Mercedes, Tex. — The Mercedes Water, Light & Power Co. has been incorporated with a capital of $100,000 to operate a local electric light and power system. The incorporators are E. B. and C. B. Witmer, and A. J. Summers.

Plainview, Tex.—The Texas Utilities Co. is planning extensions in its transmission system from Kress to Tulia. J. Scott is manager.

Waco, Tex.—The Texas Power & Light Co., Dublin, Tex., is planning extensions in its transmission system from Waco to Temple.

WESTERN STATES.

Vancouver, Wash. — The city will install a complete system of ornamental lamps on Main, Washington and 50th streets, plans for which have been prepared. Address the mayor.

Marshfield, Ore.—A special election will be held March 8 to vote on the question of issuing $110,000 bonds for an electric light and power plant. Address George P. Topping, mayor.

Salem, Ore.—Application has been filed with the state engineer by J. H. Woodcock and S. C. Woodcock of Maupin for permission to utilize 225 sec. ft. of water from the Deschutes river for power development purposes in Wasco county.

Vale, Ore.—Application has been filed by J. Edwin Johnson for 100 sec. ft. of water from the middle fork of the Malheur river for developing power to be used for pumping. It is planned to construct a hydroelectric plant to develop 3544 hp. Diversion works will consist of concrete dam with waterway, canal 5.5 mi. long, two pipes and turbine wheels. The estimated cost of the project is $350,000.

Guanajuato, Mexico.—Improvements and additions are to be made to the hydroelectric plants and power transmission system of the Guanajuato Light & Power Co. The company has been supplying electric power for the mines and ore reduction mills of the Guanajuato district for many years.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Commonwealth Edison Co.'s Showing for Last Year.

The income account of the Commonwealth Edison Co., Chicago, for the 12 mo. ending Dec. 31, 1920, is as follows:

Electric operating revenues		$35,317,134.63
Electric operating expenses (including amortization and depreciation of $2,887,428.09)		24,698,185.21
Net electric operating revenues		10,618,949.42
Other charges:		
Uncollectible operating revenue	$ 110,930.21	
Taxes assignable to electric operations	2,100,000.00	
Municipal compensation	1,040,070.62	3,251,000.83
Net operating income		7,367,948.59
Other income		679,966.73
Gross income		8,047,915.32
Deductions from gross income		815,913.58
		7,232,001.74
Interest on funded debt		2,523,599.80
Net income		$4,708,401.94
Surplus account:		
Surplus unappropriated Dec. 31, 1919		$7,614,189.26
Transferred from net income, year ending Dec. 31, 1920	$4,708,401.94	
Dividends paid during year	3,955,600.00	
Balance carried to surplus		752,801.94
Miscellaneous additions to surplus		5,209.67
		8,372,200.87
Surplus applied to other reserves (Insurance reserve and liability for provident funds.)		117,795.16
Balance surplus unappropriated Dec. 31, 1920		$8,254,405.71

Central Illinois Light Co. to Issue Bonds.

The Central Illinois Light Co., Peoria, Ill., has been authorized by the Illinois Public Utilities Commission to issue $590,800 of its 7% cumulative preferred stock, and also $1,500,000 first and refunding 5% gold bonds, to sell at 70% par. They will mature April 1, 1943.

Bond Offering of Merchants Heat & Light Co.

A new issue of $700,000 Merchants Heat & Light Co. (Indianapolis) 7.5% gold bonds, due March 1, 1936, is being offered by Paine, Webber & Co., Chicago, at 95.67 and interest, to yield 8%. The proceeds of the sale of these bonds will be applied to the payment of the $600,000 notes due March 21, 1921, the balance being available for additional working capital. The Merchants Heat & Light Co. operates three steam-generating plants located in the center of the business and manufacturing district of Indianapolis, producing electricity for power and lighting and steam for steam heating in the downtown district, and serves the residence district with electric light and hot water for heaing purposes. The company also owns and operates its own coal mine, which insures an adequate supply of fuel. The gross earnings increased from $540,396.64 in 1912 to $2,524,686.67 for 1920. For the year ending Dec. 31, 1920, the net earnings were $598,938.20, which after deducting total interest charges of $339,325, left a surplus of $259,658.20.

Brooklyn Edison Co.'s Yearly Statement.

The annual report of the Brooklyn Edison Co. for the year ending Dec. 31, 1920, contains the following statement of earnings and expenses, the figures for 1919 also being given for comparison:

	1920.	1919.
Total revenue	$13,308,868.94	$10,850,114.52
Expenses, including taxes and reserve for renewals and replacements	10,225,919.43	7,499,102.49
Gross income	$ 3,082,949.51	$ 3,351,012.03
Interest and discount	1,420,333.10	1,088,448.65
Dividends, etc.	1,509,263.17	1,488,406.42
Contingencies	.....	456,149.68
Surplus for the year	153,353.24	318,007.28
Adjustments, previous years	*240,478.19	*53,351.31
Credit to profit and loss	*$ 87,124.95	$ 264,655.97
Stock outstanding Dec. 31	$17,355,000.00	$17,306,300.00

*Deduction.

Year's Statement of Public Service Co. of Northern Illinois.

The Public Service Co. of Northern Illinois, which last year was granted increases in rates for electricity, water and gas, shows increased gross and net earnings for 1920 as compared with 1919. Earnings on the $12,063,500 common stock equaled 7.47%, compared with 7.38% the preceding year. The balance sheet as of Dec. 31, 1920, shows total current assets of $5,279,800 and current and accrued liabilities of $2,559,444. The following is the income account for the 12 mo. ending Dec. 31, 1920:

Operating revenues	$11,415,087
Operating expenses and depreciation	7,633,997
Net operating revenues	3,781,090
Uncollectible operating revenue	34,662
Taxes assignable to operations	432,000
Net operating income	3,314,428
Other income	234,853
Gross income	3,549,281
Deductions from gross income	272,110
Interest on funded debt	1,911,395
Net income	1,365,776
Preferred dividends	464,770
Common dividends	781,139
Surplus for year	119,867
Total surplus Dec. 31, after adjustment	1,441,297

Pacific Power & Light Co.

	1920.	1919.
November gross	$ 256,116	$ 205,810
Net after taxes	128,867	99,906
Total income	136,834	100,546
Surplus after charges	82,281	57.250
Twelve months' gross	2,613,047	2,148,458
Net after taxes	1,179,161	1,040,138
Total income	1,207,271	1,051,665
Surplus after charges	640,033	510,223
Balance after preferred dividends	435,283	320,679

United Gas & Electric Corp.

	1920.	1919.
December gross	$1,165,429	$1,041,469
Net after taxes	316,274	340,883
Total income	349,906	373,467
Surplus after charges	127,108	163,077
Twelve months' gross	12,144,107	10,276,247
Net after taxes	3,624,568	3,494,006
Total income	3,920,832	3,691,212
Surplus after charges	1,402,257	1,418,678

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Feb. 22.	Bid Mar. 1
Adirondack Electric Power of Glens Falls, common	6	13	13
Adirondack Electric Power of Glens Falls, preferred	6	71	71
American Gas & Electric of New York, common	..	103	103
American Gas & Electric of New York, preferred	6	37	37
American Light & Traction of New York, common	..	108	110
American Light & Traction of New York, preferred	6	80	81
American Power & Light of New York, common	4	47	50
American Power & Light of New York, preferred	6	65	66
American Public Utilities of Grand Rapids, common	..	8	7
American Public Utilities of Grand Rapids, preferred	7	17	16
American Telephone & Telegraph of New York	..	99	99
American Water Works & Elec. of New York, common	..	3	3½
American Water Works & Elec. of New York, particip	7	5½	6½
American Water Works & Elec. of New York, 1st preferred	..	40	39
Appalachian Power, common	..	4	3
Appalachian Power, preferred	7	22	23
Cities Service of New York, common	+extra	248	243
Cities Service of New York, preferred	6	69	67
Commonwealth Edison of Chicago	8	102	106
Comm. Power, Railway & Light of Jackson, common	..	13	13½
Comm. Power, Railway & Light of Jackson, preferred	6	34	33½
Federal Light & Traction of New York, common	..	6½	6½
Federal Light & Traction of New York, preferred	..	42	42
Northern States Power of Chicago, common	..	49	48
Northern States Power of Chicago, preferred	ex.div.	79	79
Pacific Gas & Electric of San Francisco, common	..	47½	48
Public Service of Northern Illinois, Chicago, common	..	71	71
Public Service of Northern Illinois, Chicago, preferred	6	81	81
Standard Gas & Electric of Chicago, common	..	12	12
Standard Gas & Electric of Chicago, preferred	8	36	35½
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1¼
Tennessee Railway, Light & Power of Chattanooga, preferred	6	5½	5½
Western Power of San Francisco, common	..	25	24½
Western Union Telegraph of New York	extra	87	88
Industrials—			
Electric Storage Battery of Philadelphia, common	4	98	98
General Electric of Schenectady	8	128	129
Westinghouse Electric & Mfg. of Pittsburgh, common	7	46	46